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**Grinding Competition**

Walter R. Hedeman has been declared the winner of the prize of $35, offered in the August issue for the best article on grinding, which reached this office on or before October 1. Mr. Hedeman's article appears elsewhere in this issue and gives the conclusions reached after an exhaustive study of the whole subject. The selection of the shape and grade of grinding wheels for different purposes has not generally received the attention it deserves, nor do most shops give the care they should to keeping the wheels in the proper condition, running at the proper speed, or provide instructions for the proper manner of using them. Mr. Hedeman's article fully covers all of these features, and will, no doubt, have a strong influence toward correcting these omissions.

**Freight Car Repair Costs**

The master car builder of a large railway attributes the rapidly increasing cost of the maintenance of freight equipment mainly to four causes: the rapid introduction of heavy locomotives; the promotion of firemen inexperienced in the handling of locomotives, to the position of locomotive engineer; the indiscriminate use of heavier cars in the same train with light ones; and the sawing back and forth necessitated at passing tracks by the operation of a dense traffic in heavy trains on single track lines. The heavy locomotive has undoubtedly come to stay and the only way to overcome the difficulty caused by heavy motive power is to build cars strong enough to withstand such usage. Some railway managers have been broad minded enough to see this, but a large amount of needless car repair expense can be traced directly to a policy of cheapness in first cost, regardless of maintenance results. Education and discipline, intelligently administered, will go a long way toward making careful engineers out of young men who are careless mainly because they are inexperienced. The remedy for the second difficulty would seem to be the provision of an ample number of competent road foremen; and the application of these two remedies should, to a large extent, provide relief from damage due to the other two causes as well.

**Department Organization**

In the November issue there appeared an article which discussed the organization of engine houses at some length. In this issue R. S. Mounce presents the diagrams with a brief explanation of the organization of the whole mechanical department of the Erie Railroad in which there has been a number of important changes made during the past year. These have now been in effect long enough to indicate that they were wisely made. An inspection of the diagram will show that in general the principles of good organization have been followed. The paths of authority and responsibility are clearly defined and proper appreciation has been given the value of a sufficient staff for the general mechanical superintendent.

Because this is a good organization for the mechanical department of the Erie does not necessarily prove that it is the best one for the mechanical department of some other road. The determination of the best organization in each case can only be reached after a most careful study of not only the local conditions, but the personnel of the department throughout. If the result is good, it will be capable of being easily diagrammed and will have a minimum number of officers with divided responsibility. In view of the necessity for full co-operation between the operating and the mechanical departments for the most efficient service in both, there will of necessity be some divided responsibility, particularly in the case of the road foreman of engines. The same condition exists between the locomotive and car departments, and in the case of the Erie it will be seen that the mechanical superintendent of the car department transmits his instructions to the divisional foreman in

charge of car repairs through the mechanical superintendent and master mechanic.

Furthermore, a good organization will permit of a brief description and simple short instructions that will give every officer in the department accurate knowledge of the exact limit of the authority and responsibility of himself and every one else in the organization. Can this be done in your department or in your shop?

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**Freight Car Repairs**

A damaged car comes to the repair track with several broken parts which failed under fair usage. Is it wisdom or economy to replace the broken parts with others of exactly the same design and construction? If you do, have you any cause to expect that the car will not appear on the repair track at the next division point? To be sure, most roads are doing just this, but can't you conceive of a better practice? If you can, write it out and send it to us for publication. You may win a prize of $50 if it reaches this office before February 1, and in any case, if it is used, you will be fully recompensed. What do you know about box car roofs? Is it advisable to put an all-metal roof on a wooden framed car? Is the all-metal roof better than an inside or an outside metal or an all-wood roof, in any circumstance? Have you any facts to back up your conclusion? Send them to us, we want your ideas on these subjects. The same applies to the design of freight cars of all classes, as well as to passenger cars; draft gear design and application; the best organization of forces in car repair yards or shops; the ventilation of steel passenger cars; in fact, articles on any subject of interest to the car department will be accepted in this competition if they reach this office before February 1, 1914. Announcement of the winner will be made in the March issue if possible, and all articles which do not win a prize but are accepted for publication, will be paid for at our regular space rates.

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**More Care in Bolt Making**

A recent examination of the bolts in a storehouse of a large railway system disclosed the fact that many were considerably under size. Out of 21 bolts picked up at random 14 were more than 0.005 in. under size, 4 were 0.005 in. under, 2 were 0.005 in. over size, and only one was of the exact size. The greatest variation found was 0.03 in. under size which in a ½ in. bolt would reduce the tensile strength of the bolt 14.7 per cent., and in a 1 in. bolt 7.1 per cent., reducing the factor of safety in both cases by similar percentages. The threading of bolts is one of the large jobs in a railway shop that is given little attention. A speaker at the last Tool Foremen's convention, when telling of the poor results obtained from the dies said, "the general impression in shop practice is that anything with two legs can run a bolt cutter or other thread-cutting machine." In another case a foreman of the bolt shop, who was placed there on account of his driving capabilities, was found cutting the threads on one size of bolts with the dies of the next smaller bolt size, because, as he stated, it saved time and increased the production.

While this work may be considered rough work in which refinement is not necessary, it is certain that it must not be neglected altogether, not wholly on account of the reduction in the strengh of the bolt, but from a production cost standpoint. The production on different roads will vary from 5,000 to 50,000 bolts with one sharpening of the dies, and those roads having the smallest production will have the greatest trouble with the die heads. Keeping both the machines and dies in good condition, and instructing the workmen to operate the machines properly, will all tend to lower the cost of production and provide a bolt that can be relied on. In the report of the Tool Foremen's Association it was stated that the Big Four was able to hob all of its bolt dies for the whole road in a standard head in the tool room as the bolt machines were maintained in good condition. On most other roads it is necessary to send out the blank dies and have them hobbed on the machine in which they are to be used. On the Central of Georgia all bolt dies are removed each morning and exchanged for other sets at the tool room, the old dies being examined by the tool experts and repaired when necessary. This eliminates any chance of poor work from the machine operator and insures a properly threaded bolt. Is there any good reason why other shops should not do as well?

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**Preparing for Winter**

A great deal of work is necessary by the motive power department each fall in repairing locomotives and shops for the winter months. It is often very difficult to have all these preparations completed before the first signs of cold weather appear, but by systematic action a great deal can be accomplished. Storm windows for shops and engine houses always have more or less glass broken when they are removed in the spring and the windows should be taken out of storage in ample time to have this glass renewed before they are needed. A very good method of handling this is to make the necessary repairs when the windows are taken down in the spring. If a proper storage place is provided there should be no danger of more breakage taking place during the summer and it is then only necessary to clean the windows before putting them in place.

Careful record should be made, before shop heating plants are closed down in the spring, of any repairs that are necessary and these should be given attention during the summer months. Repairs to a heating plant can be worked in very nicely to keep men busy on slack days during the months that the plant is not in operation.

A great deal of the difficulty attendant on the installation of side and back curtains on locomotives can be obviated by proper marking and storing of the equipment when it is taken off in the spring. This should be given prompt attention in the fall as an early cold snap or snow storm may cause much discomfort to the crew of a locomotive which has not any side or back curtains. If such equipment is properly designed it can be standardized for a great majority of the locomotives, and by putting the rods in place in the latter part of the summer, it is an easy matter to slip on the curtains when the weather begins to turn cold.

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**Standard Box Cars**

R. W. Burnett, general master car builder of the Canadian Pacific, in his paper before the American Society of Mechanical Engineers, which is given elsewhere in this issue, sees a tendency toward the adoption of a standard box car in the rapid development and uniformly satisfactory experience that has followed the introduction of the steel frame, inside sheathed car a few years ago. He points out that it is certain there will be no backward movement to a wooden superstructure and that this type of car, with possible modifications, will remain a standard car unless some superior type is developed. In support of this position, it is pointed out that a car constructed of rolled shapes seldom needs renewal of any of its framing for, even when the car is wrecked, these parts can easily be straightened and formed to the original shape at any car repair point. Even if they must be renewed, standard shapes can be quickly obtained from the mill or from stock in all of the principal cities. Mr. Burnett bases his opinion on experience with the design, construction and maintenance of 30,000 cars of this type and what he has to say is deserving of the most careful consideration.

George W. Rink, mechanical engineer of the Central Railroad of New Jersey presented a paper on steel underframes for freight cars at the same meeting. This paper is so extensive that space will allow the insertion of but part of it in

this issue. Mr. Rink has made a most careful analysis of the design of a large number of steel underframe cars. Formulas for strength of various parts are presented to be used as a basis of comparison. The study that results develops a number of interesting opinions, some of which are open to argument. Mr. Rink also makes a plea for a standard car and suggests the appointing of a committee representing the various railroads throughout the country with a view of developing a standard box car which will eliminate cars of inferior design and light construction, resulting in quicker repairs and decreased operating expenses.

While a standard car may be very advisable from some standpoints there are so many objections that can be logically raised to it that it would seem much more feasible to reach some conclusion as to the minimum allowed strength of car underframes which, combined with standard inside dimensions, would allow the designer to better adapt his construction to the service in which it was to be used. In considering a standard car it is not conceivable that any action can be taken which will force the destruction of a large number of perfectly good cars. This, in effect, means that even were a standard car adopted during the next year, the advantages could not be fully obtained for six or eight years at the earliest. On the other hand if a standard strength requirement is determined, it could be put in force within two or three years and cars already in service could be strengthened to meet this standard without prohibitive expense.

**Steel Passenger Cars**

The railroads of this country have already practically ceased ordering wooden passenger cars. The percentage of new wooden passenger train cars placed in service has dropped from 51.4 per cent. during 1909 to 3.3 per cent. during that part of 1913 thus far reported. During the first six months of the present year no wooden cars were ordered. This is one of the reasons why no hasty or ill advised action should be taken by Congress in connection with legislation, forcing the railroads to use only steel equipment, as is set forth in a well digested study of the steel passenger car situation which appeared in the November 21 issue of the *Railway Age Gazette*. It is pointed out that no drastic mandatory statute is called for when those affected are already doing voluntarily what is sought. It is further pointed out that the maximum capacity of the present car building plants of the country for steel passenger cars is but slightly over 5,000 cars a year and it would thus take nearly ten years to replace the 47,000 wooden and composite cars that are now in service, even without making allowance for additional equipment required for increased traffic and new lines during that time. It would cost nearly $615,000,000 to replace these cars on the basis of an average cost of only $12,800 each. As a matter of fact, steel passenger cars cost considerably more than this at the present time. One steel car builder is the authority for the statement that steel passenger cars cost from $14,000 to $17,000 each.

When it is considered that only 3.1 per cent. of those killed and 21.4 per cent. of those injured on railways are passengers, and further that less than one-half of the passengers killed were in collisions or derailments, the passing of a mandatory statute compelling this large expenditure would hardly seem desirable. In the same connection it must be considered that safety measures other than steel cars are badly needed. No wrecks were ever prevented by the use of steel cars and the wiser course seems to be to make investments for block signals and for the maintenance of better discipline, both of which will actually tend to prevent accidents. In the case of collision, it is beyond contradiction that the steel cars will prevent loss of life and reduce injuries. This feature of the case is well summed up in a recent report of the New York Public Service Commission of the Second district which states: "The enormous cost that would be required to replace the present equipment of wooden cars in advance of the natural movement in that direction, coupled as it would be with more or less diversion of funds needed for the prevention of accidents, to a purpose that only minimizes the effect of accidents which ought not to have occurred, is one of the considerations to be given proper weight in the study and investigation which we strongly favor."

It is further pointed out in this study that nobody at the present time can draw a bill specifying the type of car which will best insure safety, because expert opinion still differs as to the respective merits of all-steel, steel frame and steel underframe construction and other important details involving both safety and cost. On this phase of the subject the result of the investigation led to the conclusion that the steel underframe car, and more particularly the steel frame car, may be made as strong as the all-steel car and because of their behavior thus far, will probably be included under the classification of steel cars if action is taken by Congress to force the railroads to adopt such equipment.

## NEW BOOKS

*Proceedings of the Fifth Annual Convention of the Tool Foremen's Association.* Bound in paper. 6 in. x 9 in. 133 pages. Illustrated. Published by the Association, A. R. Davis, Central of Georgia Ry., Macon, Ga. Price 50 cents.

These proceedings contain a full report of the recent convention held in Chicago. Many interesting topics were discussed, among which was the reclamation of tool steel, the form of thread and degree of taper for boiler studs and plugs, forging machine dies, thread cutting dies, and superheater tools. This association is made up of expert tool makers, and there is much valuable information contained in its proceedings.

*Strength of Materials.* By Mansfield Merriman. Sixth edition, revised. Illustrated, bound in cloth, 166 pages, 5 in. x 7½ in. Published by John Wiley & Son, New York. Price $1.

Merriman's Strength of Materials is too well known as a text book to require any extended description. The first edition was issued in November, 1897, and it has now passed to the sixth edition, each being revised to keep pace with the advance of knowledge in this field. In the fifth edition a new chapter was added on reinforced concrete, especially columns and beams and in the sixth a new chapter on combined stresses has been added. Numerous changes have been made throughout the book and many new problems have been introduced. This standard work offers an opportunity for the study of the strength of materials, beams, columns and shafts which may be understood by those not acquainted with calculus. The degree of mathematical preparation required for an understanding of the problems presented is merely that now usually given in high schools. The book deals mainly with questions of strength, the subject of elastic deformations occupying a subordinate place. Since the deductions of the deflection of beams are best made by calculus, they are not here attempted, but the results are stated so that the pupil or reader may learn their uses. A chapter on the manufacture and general properties of materials is given as well as one on resilience and impact.

*Railway General Foremen's Association Proceedings,* 1913. Bound in paper. Illustrated. 173 pages. 6 in. x 9 in. Published by the Association, William Hall, secretary, Winona, Minn. Price $1.

The International Railway General Foremen's Association occupies an important field which is not covered properly by any of the other numerous mechanical associations. That its officers and members fully appreciate their responsibility is well illustrated by the work of the ninth annual convention held at Chicago in July, 1913. The proceedings fully demonstrate their activity and in addition to the verbatim account of the discus-

sions and the full text of the reports, it includes the subjects and the chairmen of committees to report at the next convention.

*Air Brake Association.* Proceedings of the twentieth annual convention. Bound in leather, 321 pages, 6 in. x 9 in., illustrated. Published by the Association, F. M. Nellis, 50 State street, Boston, Mass., secretary. Price $2.

This association is one of the most logical associations in the railway field. Its meetings are well attended, and the information presented is of great value to the men engaged in the maintenance and operation of air brake equipment. Many of the vagaries of the air brakes are discussed and means found for their elimination. This association perhaps more than any other similar association, calls on the engineering staffs of the manufacturers of air brake equipment and supplies for information that they are able to give concerning special investigations made in their respective lines. This year's proceedings contain papers on Undesired Quick Action; Operation of Long Freight Trains; Operation of the Triple Valve; Air Hose Failures; Location of Steam Heat Traps, and a report of the committee on Recommended Practice.

*Master Blacksmiths' Association Proceedings, 1913 Convention.* Bound in cloth. 236 pages, 5½ in. x 8¼ in. Illustrated. Published by the association, A. L. Woodward, Secretary, Lima, Ohio.

A general report of the twenty-first annual convention of the Railroad Master Blacksmith's Association appeared on page 485 of the September issue of this journal. While this account covered the essential parts of the reports and discussions, those who wish to investigate the subject more fully will find the complete report on each subject as well as a verbatim account of the discussion in the proceedings. The papers this year were on the following subjects: Flue Welding; Tools and Formers; Electric Welding; Drop Forgings; Piece Work; Case Hardening; Oxy-Acetylene Welding and Cutting; Heat Treatment of Metals; Cast Steel in the Blacksmith Shop, and Efficiency. The same fault exists in this association that is seen in so many of the other mechanical meetings, that an attempt is made to handle far too many subjects for the length of time allowed. The consequence is that nothing is done completely and no important conclusions are reached. In spite of this however, the work at this convention is interesting and, to a certain degree, valuable.

*Traveling Engineers' Association Proceedings, 1913 Convention.* Bound in flexible leather. 371 pages, 5¾ in. x 8½ in. Illustrated. Published by the Association, W. O. Thompson, secretary, Buffalo, N. Y. Price $1.50.

The twenty-first annual convention of the Traveling Engineers' Association, held in Chicago, August 12-15, 1913, fully maintained the reputation of previous meetings for the practical and beneficial manner in which the subjects were treated. Reports were made on: Uniform instructions to enginemen on the handling of superheater locomotives; Credit due to the operating department for power utilization and train movement that reduces consumption of fuel; What can be done to eliminate the black smoke evil on locomotives; Advantages obtained with the brick arch in locomotive service, and, Care of locomotive brake equipment on line of road and at terminals. In each case the discussion was thorough and extended. In addition to the reports, a number of prominent railway officials were invited to address the meetings. The speakers included W. L. Park, vice-president of the Illinois Central; W. A. Garrett, vice-president of the Chicago Great Western, and W. J. Tollerton, general mechanical superintendent of the Chicago, Rock Island & Pacific. The proceedings contain the full text of the reports, discussion and addresses and an index of the subjects brought up at each convention since 1893, when the association was organized. The subjects for discussion which will be presented at the next convention and the committees having them in charge are also given.

# COMMUNICATIONS

## COLLEGE MEN AND THE RAILROADS

State College, Pa., October 21, 1913.

To the Editor:

There are many answers to this question. "Because there are plenty of recruits to fill the ranks, and when one drops out it is a pretty sure indication that he lacks stability of purpose," says a railroad official. "Because he is required to spend years doing the work of a machinist rather than applying directly what he has spent four years to acquire," adds a college teacher. "Because he can get a better job," replies a special apprentice. Each may be in part right, yet somewhere there is something radically wrong.

The railroad can hardly excuse itself by saying that it does not secure the graduates of the desired mental make-up and personal qualities and that the college alone should bear the brunt of any unfavorable results. On the other hand, the technical school has no right to maintain that, although it should confine itself to fundamentals, its very existence demands practical instruction along certain lines, as in stationary practice, but the obligation does not concern itself with railroad mechanical problems, although 10 to 20 per cent. of the students going out may enter some line of railroad service. While such diverse opinions too commonly control the situation, the two main interests concerned do not come together in close working relations. In the meantime the special apprentice takes a place with more immediate promise and better pay—and the ranks are filled up again. Is not this a conservative statement of the situation? What is the first step in bettering the condition?

Your correspondent in the October issue gives a remedy which I would modify as follows: Make the special apprentice course three years, instead of two as suggested, six months of the total to be taken during summer vacations, as is being tried out successfully. If he gives evidence of being the type of man qualified for advancement, make it worth his while to remain; if he is not, tell him so. The result will be a sifting process, as it now is, but the method will be more business-like.

Seven students from different colleges began summer work last June in the shops of a certain railroad. By September, but one of their number was still in the employ of the company. Two said that the city air did not agree with them in the summer, although they appeared to be in perfect health and had passed the physical examination; but the master mechanic, a well known railroad engineer who was looking for young men of fixed purpose and mature judgment, was disappointed. The one who "made good" is asked to go with this company on finishing at college, receiving for the time spent in summer work credit on his three year special apprenticeship course. Unless, however, the company pays him a living wage, he will seek a place where he can soon pay off the debt of money borrowed to finish his college course. Having selected a man by the process of elimination, is it not a short sighted policy to pay him less than a fair living wage?

As pointed out in your editorial in the October number the engineering principles taught are not commonly applied to railroad mechanical problems. Moreover, the college professor or instructor is called on to suggest men for places with railroads the nature of the requirements of which he is confessedly ignorant. This is not right. The case cited above of the seven students doing summer work is an extreme one. The writer has known personally over two hundred undergraduates who have done good work and stuck to their jobs during two or three months in the summers between college years.

Under the title, "How Can the Colleges and Industries Co-operate?" I. L. Lee, executive assistant, Pennsylvania Railroad, presented at the last annual meeting of the Society for the Pro-

motion of Engineering Education, a composite of the views of the higher officials of that railroad.* The essence of the criticisms is summed up in the following:

"Let me be concrete. It is the experience of the Pennsylvania Railroad officers that graduates who come to them from technical schools are deficient in three general particulars:

"1. Lack of practical experience and judgment.

"2. An idea that they are far superior to the rest of mankind.

"3. A certain narrowness of mind, inculcated through a too exclusive attention in college to mathematics and theoretical science, and a too great neglect of those broader subjects, such as political economy, history and general literature."

Here we have a frank statement worthy of serious consideration. The suggestion for bettering the college conditions, as made by Mr. Lee, proves that the railroad concerns itself with a solution. In close relation with the subject of this discussion, the writer would add the following comments suggested by Mr. Lee's discussion.

(1) The lack of practical experience would not seem to be as serious a charge as others which could be made. In the average span of life, the young man will have thirty or forty years of practical experience as against four years of study confined largely to theory. I take it that the central purpose of a general college training is to teach men to think for themselves, to develop self-mastery and to value things for their true worth; but it is not the place to train a specialist. Any American technical school which would today attempt to teach strictly within the limits of this purpose, without giving instruction in the practical applications of the science, would soon lose recognition, for the requirements of the commercial interests are justly exacting. New methods leading to a more experienced graduate are being adopted.

As an example, in addition to the practical instruction given at the Pennsylvania State College, each student is required to spend a total of 18 weeks in outside engineering employment during the summer months before he reaches his senior year. After a close study of results in mechanical engineering covering a period of three years, the writer is confident it is developing a more experienced young man with a better judgment and one who has a higher wage-earning value, even at the beginning of his apprenticeship.

(2) I have known but very few cases where the railroad organization did not soon level off the high places in the sense of superiority—better termed "big head" conceit—where such a weakness has been his heritage from a college training. Any college which fosters such a spirit is doing the young man a serious harm; while, on the other hand, if it develops self-assurance without over-confidence, the college has done a service.

(3) On the third count raised by Mr. Lee, it may be well to note what the colleges are now doing in their division of time for the different subjects taught. Below are given the average results of percentages of time allotted to group subjects in mechanical engineering courses in ten leading colleges of the country. This table was made up four years ago, but the few alterations since that time would change but slightly the averages here given.

| Subjects. | Per cent. of total time course. |
|---|---|
| Languages and English | 9.64 |
| History and economics | 2.53 |
| Mathematics | 11.91 |
| Physics | 7.20 |
| Chemistry | 5.81 |
| Drawing | 4.55 |
| Shops | 8.82 |
| Mechanics | 6.83 |
| Metallurgy | 1.01 |
| Electrical engineering | 3.97 |
| Civil engineering | 4.39 |
| Machine design | 14.17 |
| Strictly mechanical engineering subjects | 16.05 |
| Electives and special | 3.12 |
| Total | 100.00 |

*Bulletin of the Society for the Promotion of Engineering Education, October, 1913.

At the Pennsylvania State College, the combined percentage for language (including English), history and economics is eighteen, which represents more than the total for the combined mathematics and physics. It will be noted that this is higher than the corresponding percentage for the ten colleges mentioned. The student may not get enough English and economics, but it is certainly true that they do not get too much mathematics, physics and mechanics. The above percentages are not estimates; they are cold facts worthy of a critic's study.

It may be added that in the railroad mechanical engineering course of the above mentioned college, given in the last year and a half of the four in mechanical engineering, 11½ college credits out of 16 or 17 per cent. is strictly railroad work, part of the instruction being in the theory of locomotive operation, and locomotive, dynamometer-car and air brake tests. Only those expecting to go into railroad mechanical work take this course, and it is the underlying thought to make the instruction of a nature to bridge the gap between college and active railroad service but without over-specialization or at the expense of a single fundamental mechanical engineering subject. A few other colleges are doing as much or more.

But we must look deeper than what is being taught. As in most lines of engineering, so in railroad service, more men fail from lack of desirable personal characteristics than from a lack of technical knowledge. Back of any subject studied, is the personality of the teacher, and back of the lesson learned is the character of the student who is to assimilate the facts and apply them. How can the college do the most for the boy in four years, is a problem, and its obligations are equally exacting on the personal side as on the side of mental training.

Weighing in the balance of calm judgment the various considerations, one is led to believe that if the colleges will have on their teaching staffs men of directing force who are experienced in railroad mechanical work, and if the railroads will cooperate in a way to select and hold more men fitted for the service, then with these forces united to effect a closer working relation and sympathy between the two, there will result some notable changes in present day methods.

It may be in place to suggest a conference representing the joint interests, held possibly at one of the winter meetings of the railroad section of the American Society of Mechanical Engineers, where a discussion of conditions will open the way for a better understanding of the other man's problem.

ARTHUR J. WOOD,
Associate Professor Railroad Mechanical Engineering.

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B——, Pa., October 28, 1913.

TO THE EDITOR:

My observation and experience with college men in railroad work has been that the majority of them when first leaving college and starting in real work, are not worth holding. There is no doubt but that the majority of college courses could be improved upon, and that they do not properly fit the man for railroad work. The majority of college men do not fully realize and appreciate what the word "Commencement," when applied to graduating exercises, really means.

A man spends four years at college intending to learn something. During these four years he gets the impression that he is going to learn everything, and generally graduates with the idea that he does know everything. The result is that it takes him about four years of hard work to find that he does not. A great many young men, while in college, have the idea that the world was made for them, and that while in college they are going to learn everything which they will possibly require when entering actual work. I believe the man who wrote the article appearing in the October issue of the *American En-*

*gineer,* and who signed his initials I. I. W. is one of these young men. For instance, towards the bottom of the first column on page 524, he states, "Any man who is a graduate Mechanical Engineer, if he is any good at all, can, with the right system, get all that is necessary out of the shops in two years." This to me is the height of egotism, as the shop is the basis of the mechanical department of a railroad. Any man who feels that he can work in a shop for two years and learn all that there is to be learned in regard to shop practice on railroads, should be bright enough to make a living without working.

In the second column on page 524, the writer speaks of the shop graduates being turned into the test department where they are given work far beneath their capabilities, such as odd drafting jobs, computing and tabulating road tests, etc. I have never seen a college graduate, either at the beginning or the end of his special apprentice course, properly tabulate a test, for the reason that he has not had the experience to teach him the various points to be brought out. I distinctly recall one special apprentice who intended to make a road test of a locomotive. He was of the usual type of college graduate and knew it all. The result was that he could not even start the test, because he would not be told how to do it, and it was necessary to take him off and put a regular apprentice from the shop on the job. The regular apprentice was willing to learn and willing to be told, with the result that today he is a thoroughly reliable and accurate man on this class of work. I call to mind another college graduate who started in the mechanical engineer's office as draftsman's apprentice. At the end of six months, he was discharged for the reason that he was not willing to be told.

If the college man expects and desires to make a success of railroad work, or any other work, he has got to start in at the bottom. You will find that when any man is given a position of responsibility, it is generally on account of his judgment, which comes only with years of hard work and actual contact with the subject in hand. R. L. A.

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Chicago, Ill., October 28, 1913.

To the Editor:

In connection with the discussion of the college-trained man and the railroads, it seems to me that the fault is with our educational system, and that we are beginning to realize it is evidenced by the advocacy of vocational education. We have an object lesson in the manner in which Germany and other countries are handling these questions. They assimilate the college man readily in the industrial life by making him fit in school for the particular vocation he elects to follow. When he reaches a certain degree of efficiency, his progress is more rapid and more certain than the man who has been deprived of such advantages.

There are comparatively few responsible official positions on the railroads. The competition for them is sharp, and great personal risk is necessary in some of the most desirable branches. There is also the necessity for social deprivation, great personal endurance, resourcefulness, and self-denial. Many who are ambitious have not all of these requisites, whether from the ranks or the college. More fail who are not college men than who are, as the proportions are greater.

When our railroads have progressed more in the refinements, when the rates will permit the same ratio of expenditure for maintenance and operation as are enjoyed in the older countries, there will then be less required of the individual official, and there will be more opportunities, with less responsibility at the foot of the ladder. The college man will then perhaps take a more lasting interest in the work. There will be greater opportunity for social enjoyment, as the first few years will in all probability be less arduous, subject him to fewer risks, and require less resourcefulness.

The railroads cannot change the existing conditions. It will come about in a natural evolution. W. L. Parh.

Vice-President, Illinois Central.

## TURNING DRIVING WHEEL TIRES

Clifton Forge, Va., November 5, 1913.

To the Editor:

On page 336 of the June issue appeared a record for turning driving wheels made at the Richmond shops of the Chesapeake & Ohio on a new model driving wheel lathe furnished by the Niles-Bement-Pond Company. This reported a record of four 56-in. wheels turned in 2 hrs. 7 min. At the Clifton Forge Shops we have recently been able to considerably reduce this time on the same type of machine. In fact, the machine illustrated on page 336 is the one located at these shops and is the identical machine on which the following records were made. By careful attention to the details of every part of the work combined with the excellent facilities offered by the design of machine, we have been able to turn a set of four pairs of 56-in. driving wheels in 1 hr. 52 min., as is shown in the following table:

| Pair No. | Time chucking. Min. | Time finishing. Min. | Time re-moving. Min. | Time, floor to floor. Min. | Cutting speed. Ft. per min. | Diameter driving wheels. |
|---|---|---|---|---|---|---|
| 1 | 3 | 20 | 5 | 28 | 15 to 17 | 56 in. |
| 2 | 5 | 21 | 3 | 29 | 15 to 17 | 56 in. |
| 3 | 4 | 24 | 3 | 31 | 15 to 17 | 56 in. |
| 4 | 3 | 18 | 3 | 24 | 15 to 17 | 56 in. |

Average time floor to floor, 28 minutes. Depth of cut, 5/16 in. Total time to turn complete set, 1 hour and 52 minutes.

On the same machine we have also been able to turn a set of six pairs of driving wheels from a Mallet engine in 2 hrs. 52½ min. These tires were extremely hard and we consider this record exceptionally good. The details of this record are also given herewith.

| Pair No. | Time chucking. Min. | Time finishing. Min. | Time re-moving. Min. | Time, floor to floor. Min. | Cutting speed. Ft. per min. | Diameter driving wheels. |
|---|---|---|---|---|---|---|
| 1 | 4.5 | 21 | 2 | 28.5 | 15 to 17 | 56 in. |
| 2 | 7 | 22 | 2 | 31 | 15 to 17 | 56 in. |
| 3 | 6 | 18 | 2.5 | 26.5 | 15 to 17 | 56 in. |
| 4 | 3 | 21 | 4 | 28 | 15 to 17 | 56 in. |
| 5 | 3 | 22 | 4 | 29 | 15 to 17 | 56 in. |
| 6 | 4 | 23 | 2.5 | 29.5 | 15 to 17 | 56 in. |

Average time floor to floor, 28.5 minutes. Depth of cut, ¼ in. Total time to turn complete set, 2 hours and 52.5 minutes.

E. A. Murray,
Master Mechanic.

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Innovations on Argentine Passenger Cars.—The Central Cordova is placing in service several new restaurant cars. An innovation is the introduction of pianolas in the cars so that the passengers may enjoy music while dining. Some of the private cars are also to be fitted with the same class of musical instruments.

Melting Point of Commercial Copper Alloys.—As very little information on the melting points of commercial brasses and bronzes can be found in either scientific or technical literature, tests of a few typical alloys were made by H. W. Gillett and A. B. Norton of the U. S. Bureau of Mines. The results, summarized, in Technical Paper No. 60, are as follows:

| | Approximate Composition. | | | | Melting Point. | |
|---|---|---|---|---|---|---|
| Alloy. | Copper. | Zinc. | Tin. | Lead. | Deg. Cent. | Deg. Fahr. |
| Gun metal ..... | 88 | 2 | 10 | .. | 995 | 1825 |
| Leaded gun metal... | 85½ | 2 | 9½ | 3 | 980 | 1795 |
| Red brass ..... | 85 | 5 | 5 | 5 | 970 | 1780 |
| Low-grade red brass. | 82 | 10 | 3 | 5 | 980 | 1795 |
| Leaded bronze..... | 80 | .. | 10 | 10 | 945 | 1735 |
| Bronze with zinc.... | 85 | 5 | 10 | .. | 980 | 1795 |
| Half yellow-half red. | 75 | 20 | 2 | 3 | 920 | 1690 |
| Cast yellow brass.... | 67 | 31 | .. | 2 | 895 | 1645 |
| Naval brass ..... | 61½ | 37 | 1½ | .. | 855 | 1570 |
| Manganese bronze... | .. | .. | .. | .. | 870 | 1600 |

The melting point given is the "liquidus," or point where the alloy is completely molten. The temperatures are thought to be accurate within plus or minus 10 deg. C., or plus or minus 20 deg. F.

# HEAVIEST 2-8-0 TYPE LOCOMOTIVE

## For Service Where 57 in. Drivers Allow the Desired Speed. Boiler Design Carefully Studied.

Twenty consolidation type locomotives recently delivered by the American Locomotive Company to the Wheeling & Lake Erie indicate that the possibilities of this wheel arrangement for moderate speed have by no means been exhausted. For service where speed no greater than can be obtained economically with 57 in. diameter drivers, these engines prove that it is not necessary to go to the Mikado type for tractive efforts between 50,000 lbs. and 60,000 lbs.

For an investigation of this design, a comparison can be made between the Wheeling & Lake Erie consolidations and the Mikado type built in 1912 for the Delaware, Lackawanna & Western.* The latter engine was designed on the same basis as the former and was built by the same builders. It also has what the builders call a 100 per cent. boiler.

| Road | W. & L. E. | D. L. & W. |
|---|---|---|
| Type | 2-8-0 | 2-8-2 |
| Tractive effort, lbs. | 55,900 | 57,100 |
| Cylinders, in. | 26 x 30 | 28 x 30 |
| Driving wheels, diameter, in. | 57 | 63 |
| Boiler pressure, lbs. | 185 | 180 |
| Weight on drivers, lbs. | 236,000 | 237,060 |
| Total weight of engine, lbs. | 266,500 | 312,500 |
| Type of boiler | Wagon top | Straight top |
| Outside diameter of front end, in. | 82 | 86⅛ |
| Outside diameter of back end, in. | 89 | 89⅞ |
| Tubes, number and diameter | 293—2 | 304—2 |
| Flues, number and diameter | 43—5¾ | 43—5¾ |
| Tube length, ft. and in. | 15—6 | 21—0 |
| Firebox, length, in. | 114 | 108 |
| Firebox, width, in. | 84¼ | 84¼ |
| Heating surface, tubes and flues, sq. ft. | 3,293 | 4,593 |
| Heating surface, firebox, sq. ft. | 224 | 234 |
| Heating surface, arch tubes, sq. ft. | ... | 27 |
| Heating surface, total, sq. ft. | 3,517 | 4,854 |
| Superheating surface, sq. ft. | 774 | 1,085 |
| Grate area, sq. ft. | 66.8 | 63.1 |

If 1,000 ft. piston speed per minute is selected as a basis for speed, the locomotive with 57 in. drivers will make 33 miles an hour and that with 63 in. drivers will make 37.5 miles an hour. As between these two engines it will be seen that in order to obtain 2.2 per cent. greater tractive effort at this increased speed, an increase in weight of over 21 per cent. has been necessary.

When an investigation of the boiler is made, it will be seen that the Mikado type has but 11 more 2 in. tubes than the consolidation and the 38 per cent. increased heating surface is made up principally by the tubes being 5 ft. 6 in. greater in length. As is well known, heating surface added on the front end of the tubes is not as valuable as would be indicated by this percentage increase and therefore the two boilers as steam producers are by no means in the same ratio as their heating surfaces. Both of these boilers were designed to furnish a constant supply of steam for any sustained speed the locomotive cylinders are capable of making and were built according to the builders' new standard boiler proportions.

These new proportions represent a radical change in boiler designing. All the variables, such as steam pressure, tube length, tube spacing, grate area, etc., are considered. It is expected that the new ratios will be given general publicity in the near future. A further investigation of the boiler shows that the consolidation has an even greater depth of throat, measuring the distance from the top of the grate to the bottom of the tubes than has the Mikado. This has been obtained by slightly raising the center of the boiler and taking full advantage of the reduced wheel diameter. This distance in the consolidation is 24¾ in. while in the Mikado it is 24 in. The center of the boiler of the consolidation is 124 in. above the rail against 120 for the Mikado.

Other interesting features in the design are a long main driving box, a Woodard engine truck, Foulder design of main rod back end, screw reverse gear, and Vanadium cast steel main frames.

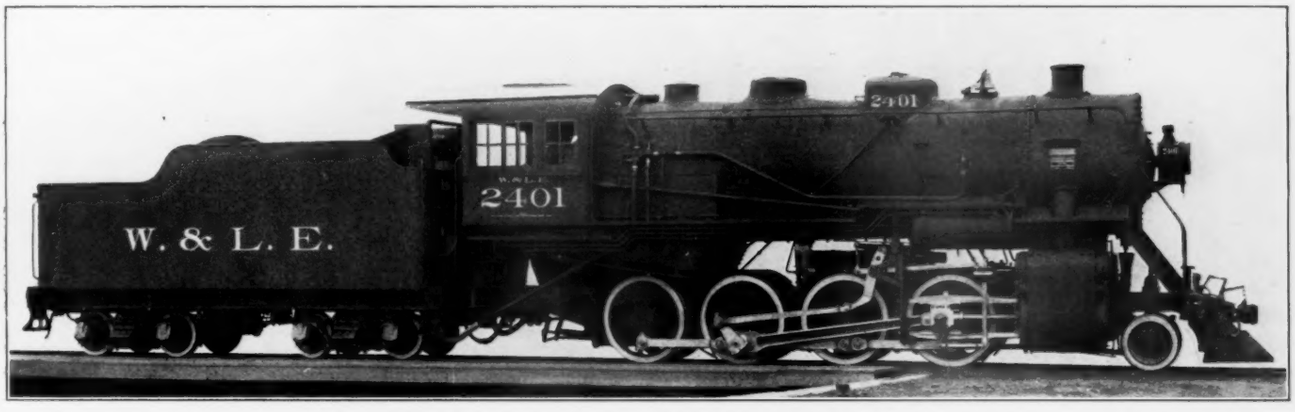
A fire brick arch was applied to one engine and the other engines are all arranged so that a stoker and arch tubes can be applied later if desired.

These engines have been put in service on the Toledo division between Brewster and Huron, Ohio, a distance of 72 miles. This division is composed of short broken grades. While all the engines are not yet in use, the difference of tonnage ratings between them and the consolidations which had previously been in use on this division, indicate that 20 of the new engines will supplant 27 of the former. The former engines have a tractive effort of 41,360 lbs. The new consolidations are handling 3,130 tons eastbound and 3,575 tons westbound at an average speed of 20 miles an hour. The old consolidations handled 2,310 tons eastbound and 2,645 tons westbound. The eastbound train loads have thus been increased 45.4 per cent. and westbound train loads 35.1 per cent.

General dimensions, weights and ratios are given in the following table:

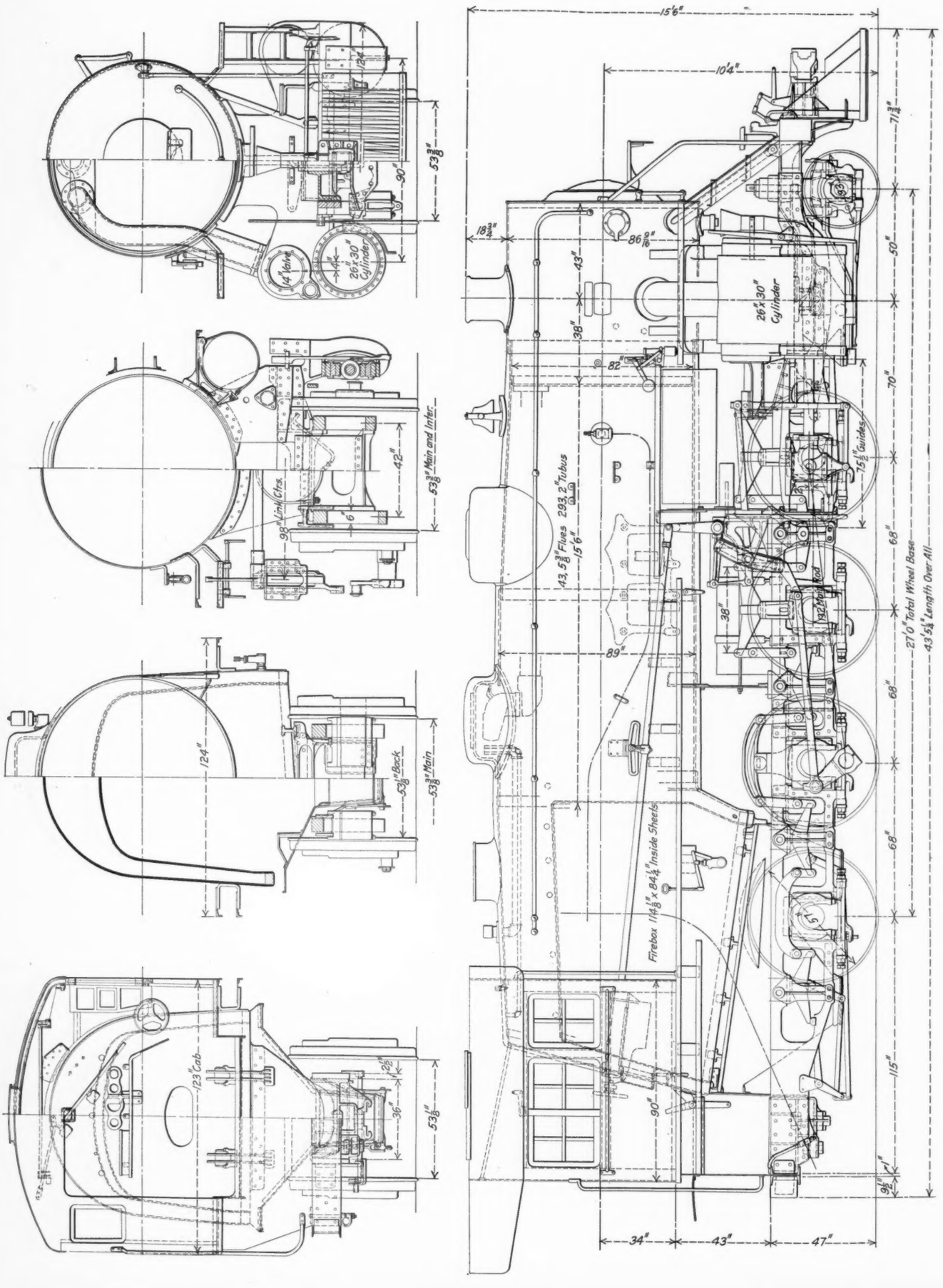
*General Data.*

| | |
|---|---|
| Gage | 4 ft. 8½ in. |
| Service | Freight |
| Fuel | Bit. coal |
| Tractive effort | 55,900 lbs. |
| Weight in working order | 266,500 lbs. |
| Weight on drivers | 236,000 lbs. |
| Weight on leading truck | 30,500 lbs. |
| Weight of engine and tender in working order | 443,800 lbs. |
| Wheel base, driving | 17 ft. |
| Wheel base, total | 27 ft. |
| Wheel base, engine and tender | 62 ft. 3 in. |




**Powerful Consolidation Type Locomotive for the Wheeling & Lake Erie.**

*See *American Engineer*, September, 1912, page 459.




General Arrangement of the Wheeling & Lake Erie 2-8-0 Type Locomotive.

*Ratios.*

| | |
|---|---|
| Weight on drivers ÷ tractive effort | 4.23 |
| Total weight ÷ tractive effort | 4.77 |
| Tractive effort × diam. drivers ÷ equivalent heating surface* | 680.00 |
| Equivalent heating surface* ÷ grate area | 70.20 |
| Firebox heating surface ÷ total heating surface*, per cent | 4.80 |
| Weight on drivers ÷ equivalent heating surface* | 50.30 |
| Total weight ÷ equivalent heating surface* | 57.00 |
| Volume both cylinders, cu. ft | 18.50 |
| Equivalent heating surface* ÷ vol. cylinders | 253.00 |
| Grate area ÷ vol. cylinders | 3.60 |

*Cylinders.*

| | |
|---|---|
| Kind | Simple |
| Diameter and stroke | 26 in. x 30 in. |

*Valves.*

| | |
|---|---|
| Kind | Piston |
| Diameter | 14 in. |
| Greatest travel | 6½ in. |
| Outside lap | 1 1/16 in. |
| Inside clearance | 0 in. |
| Lead | ⅛ in. |

*Wheels.*

| | |
|---|---|
| Driving, diameter over tires | 57 in. |
| Driving, thickness of tires | 3½ in. |
| Driving journals, main, diameter and length | 11 in. x 22 in. |
| Driving journals, others, diameter and length | 10½ in. x 13 in. |
| Engine truck wheels, diameter | 33 in. |
| Engine truck, journals | 6½ in. x 12 in. |

*Boiler.*

| | |
|---|---|
| Style | W. T. |
| Working pressure | 185 lbs. |
| Outside diameter of first ring | 83 9/16 in. |
| Firebox, length and width | 114 in. x 84¼ in. |
| Firebox plates, thickness | ⅜ in. & ½ in. |
| Firebox, water space | 5 in. |
| Tubes, number and outside diameter | 293—2 in. |
| Tubes, material and thickness | Steel, No. 11 B. W. G. |
| Flues—number and diameter | 43—5⅜ in. |
| Flues, material and thickness | Steel, No. 9 B. W. G. |
| Tubes and flues, length | 15 ft. 6 in. |
| Heating surface, tubes | 3,293.4 sq. ft. |
| Heating surface, firebox | 223.7 sq. ft. |
| Heating surface, total | 3,517.1 sq. ft. |
| Superheater heating surface | 774 sq. ft. |
| Grate area | 66.75 sq. ft. |
| Smokestack, diameter | 18 in. |
| Smokestack, height above rail | 15 ft. 6 in. |

*Tender.*

| | |
|---|---|
| Frame | 13 in. & 10 in. channels |
| Wheels, diameter and material | 33 in. rolled steel |
| Journals, diameter and length | 6 in. x 11 in. |
| Water capacity | 9,000 gals. |
| Coal capacity | 15 tons |

*Equivalent heating surface = 3,517 + (1.5 × 774) = 4,678 sq. ft.

## FIRING UP LOCOMOTIVES

Any engine house foreman is familiar with the difficulties of firing up locomotives with wood; very frequently it is too wet to burn well and excessive quantities of oil have to be used in order to get the fire started, and there is also considerable expense attached to the unloading and piling of the wood at the engine house, as well as in putting it on the locomotive. The dust and splinters from the wood make both the engine house and the locomotives very untidy in appearance and placed as it usually is, either on the front end or in the gangway, it is very much in the way of machinists and boilermakers who are working on the running repairs.

These difficulties have been largely overcome at the Norfolk & Western roundhouse at West Roanoke, Va., by the use of crude oil and shavings from the wood-working shop in the car department. Only sufficient oil is used to moisten the shavings and one bucketful is sufficient to light up one locomotive; a special bucket about 18 in. x 18 in. x 12 in. deep is used for this purpose. About 6 in. or 8 in. of coal is placed on the grate and the bucket of shavings is spread over this and lighted. The shop blower is then turned on and the locomotive has steam up ready to move out of the engine house in 30 minutes. It previously cost $6.00 a day for men to prepare wood and place it on the locomotives, this expense now being entirely eliminated.

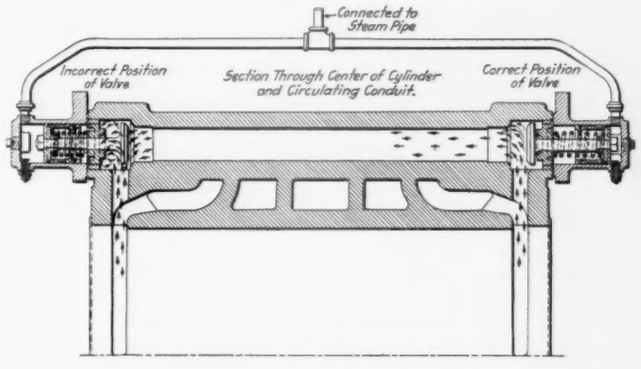
SIZE OF REDUCING VALVES.—A large percentage of the troubles experienced with steam pressure regulating or reducing valves can be traced directly to the use of valves too large for the service conditions they are required to meet.—*Power.*

## OPERATION AND MAINTENANCE OF A LOCOMOTIVE DRIFTING DEVICE

BY P. SHEEDY

Compression was not a very serious factor on locomotives when slide valves were universal, but as higher steam pressures began to be used, objections to the slide valve began to multiply. But with the advent of the piston valve, especially in mountain territory, we were confronted with the problem of caring for compression in drifting. We found piston valve engines flattened driving wheels so badly in two or three months' service that it became necessary to turn them. With the Stevenson motion on slide valves, when drifting a distance of 20 to 60 miles, it was considered advisable, in order to save the heating, wear, and tear of valve motion as well as distribute the strain between the forward and back motion eccentrics, to drift at comparatively short cut-off. In this position slide valves relieved compression by raising from seat. Thus the steam chest became a receiver and the slide valve the counterpart of the drifting device.

The type of drifting device designed by me is arranged to connect the opposite ends of the cylinder when drifting and is intended to relieve the compression on the side of the advancing piston, forcing the air through the conduit, to counteract the vacuum that would be found on the opposite end of the cylinder. Tests have shown that this is accomplished, and when drifting at short cut-off (which is desirable) both the compression and


Connected to Steam Pipe
Incorrect Position of Valve
Section Through Center of Cylinder and Circulating Conduit.
Correct Position of Valve

Section Through Drifting Valves and Passage Showing the Action for the Correct and Incorrect Positions.

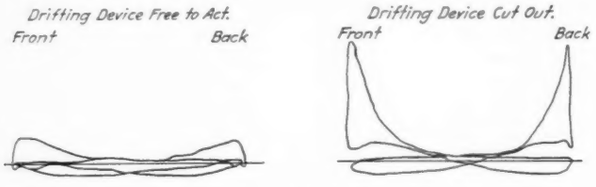
vacuum are greatly reduced. This reduction can be carried to any desired degree by enlarging the conduit and valve openings, leaving only sufficient compression to serve as a cushion for the reciprocating parts.

By reference to the illustration showing drifting cards, an idea of the value of the drifting device can be obtained. The cards were taken at speeds of from 37 to 49 miles an hour with the lever in a 10-in. cut-off position. It will be noted that with the drifting device in operation as high as 86 per cent. of terminal compression is relieved.

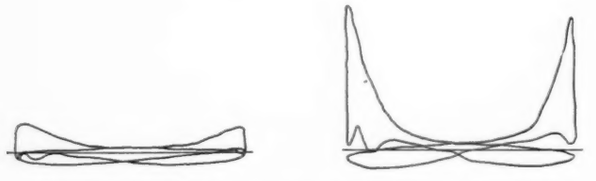
I note in the specifications for new equipment some engines are equipped with a drifting device, others have vacuum valves, and some others have both. I am quite sure it will be found that, if the drifting device is properly designed, and in proportion to the size of the cylinder to which it is applied, the application of vacuum valve in addition to the drifting device would be superfluous.

In the first place, to put the vacuum valve in operation you must relieve the cylinder of air pressure. To do this the engine must be allowed to drift at full stroke. This is not desirable, as drifting should be possible and safe at any position the lever may be in when the steam is shut off. If the main valve is operated at any point short of full stroke, vacuum valves will pulsate and it will be found difficult to keep them in service. The momentum, and wear and tear of the valve motion, is increased at

the longer travels, but this is the only way the vacuum and compression can be relieved on piston valve engines by the use of vacuum valves. Furthermore, their use means the admission of cold air to the steam chest and cylinder. This condition, perhaps, may not be so objectionable on saturated steam engines, where the maximum heat of the steam chest is not over 350 deg., but on the superheated engines it appears to be bad practice. Admitting air through vacuum valves as a means of relief, even for a short period of time, will reduce the temperature of both cylinders and steam chest to a degree that will cause condensation, with its expense and other evil effects, when the throttle is again opened.




| | | |
|---|---|---|
| 10 | Cut off position of Reverse Lever | 10 |
| 41 | Speed Miles Per Hour | 41 |
| 5.77 | Mean Back Pressure on Piston Lbs. Sq. In. | 7.2 Lbs. |
| 100 H.P. | Total Back Power of Pistons in H.P. | 126 H.P. |
| | Percent Power Relieved by | |
| 21% | Action of Drifting Device. | |
| 10 Lbs. | Terminal Compression above Atmos. Lbs. | 60 Lbs. |
| | Percent of Terminal Compression Relieved | |
| 80% | by Action of Drifting Device. | |



| | | |
|---|---|---|
| 10 | Cut Off Position of Reverse Lever | 10 |
| 47 | Speed Miles Per Hour | 49 |
| 6.37 | Mean Back Pressure on Piston Lbs. Sq. In. | 10 Lbs. |
| 130 H.P. | Total Back Power of Piston in H.P. | 210 H.P. |
| | Percent Power Relieved by | |
| 38% | Action of Drifting Device. | |
| 11 Lbs. | Terminal Compression above Atmos. Lbs. | 60 Lbs. |
| | Percent of Terminal Compression Relieved | |
| 81% | by Action of Drifting Device. | |

| | | |
|---|---|---|
| 10 | Cut Off Position of Reverse Lever | 10 |
| 38 | Speed Miles Per Hour | 37 |
| 48 Lbs. | Mean Back Pressure on Piston Lbs. Sq. In. | 6.46 Lbs. |
| 78 H.P. | Total Back Power of Pistons in H.P. | 104 H.P. |
| | Percent Power Relieved by | |
| 25% | Action of Drifting Device. | |
| 6½ Lbs. | Terminal Compression above Atmos. Lbs. | 47 Lbs. |
| | Percent of Terminal Compression Relieved | |
| 86% | by Action of Drifting Device. | |

**Indicator Cards Showing Pressures With and Without a Drifting Device.**

I find that there is an erroneous idea in regard to the higher temperature maintained when using the drifting device instead of the vacuum valve, attributing it to more front end gases drawn into the steam chest with the drifting device than with the relief valve. This conclusion is a mistake. The drifting valves simply allow a free passage of air in the cylinder to pass back and forth, maintaining the temperature by the elimination of cold air. A number of tests in saturated steam engines, where temperatures were taken at from 300 to 350 degrees, showed a drop in temperature of 100 degrees or more when using relief valve, and a maximum drop of 39.5 deg. when using drifting valves. This result would be greatly magnified if taken on a superheated engine, especially in cold weather.

In connection with maintenance, I find the principal complaint has been on account of maintainers restricting the opening through the valves. There is no danger of getting too much opening, but great danger of too little. An illustration of this is seen in the accompanying drawing, which shows at the left how air gets behind the valves and, with the spring, causes a pulsating movement at every stroke of the piston, when there should be but one movement of the drifting valves to open when the throttle is closed and another movement to close when throttle is opened. The correct position is given at the right of the illustration on page 643.

Broken valves and worn seats are entirely due to a mistaken idea that it is the slam of the valve in closing that does this and the drifting valve travel is frequently shortened to cure this supposed trouble. This actually increases the trouble by making it a pulsating valve.

When engines are received from the builders, the drifting valve should be looked over to see that the parts and conduits are free from fins and of the intended size. It should not be less than 2 per cent. of the area of cylinder at any point.

It has been found advantageous to apply a ¼-in. pet cock in the center of the conduit between the valves and make it a permanent fixture. This, when used, will show whether valves are tight when working steam and a leak of this pet cock would indicate that the valves were not seating properly.

We find in new engines that occasionally the cages which carry the drifting valves are sometimes out of line with the valve seat, and if in line, the bevel of seat is sometimes out of true with the face to which the cage is attached. When irregularities of this kind occur, it is a good idea to have a false plate fitted securely over the studs and cage. A reamer can then be used to make the seat true. When the cages and valves are applied, they should be tried by air pressure in the cage, using a two-way valve for the operation. This will admit of forcing the valve to its seat. The use of the two-way valve will allow this to be done as often as may be necessary. The cage should then be removed to see that the valve is properly seated. This method is used instead of grinding when there are indications of a leak, and in addition to seating the valve, will show that it is in line.

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A Valuable Invention.—Doctor McWilliams, of this city, has taken out a patent for a stove for heating carriages of all kinds, which is one of the most valuable inventions which has ever been made. It is remarkable in its structure and may be sold for $6 or $8; and it consumes the most inconsiderable quantity of coal. This stove is now used in the cars of the Baltimore & Washington Railroad and gives entire satisfaction. The passengers are kept warm during the cold journey and are never annoyed by smoke, the stove being air tight.—*Extract from the Washington Mirror in the American Railroad Journal, January* 30, 1836.

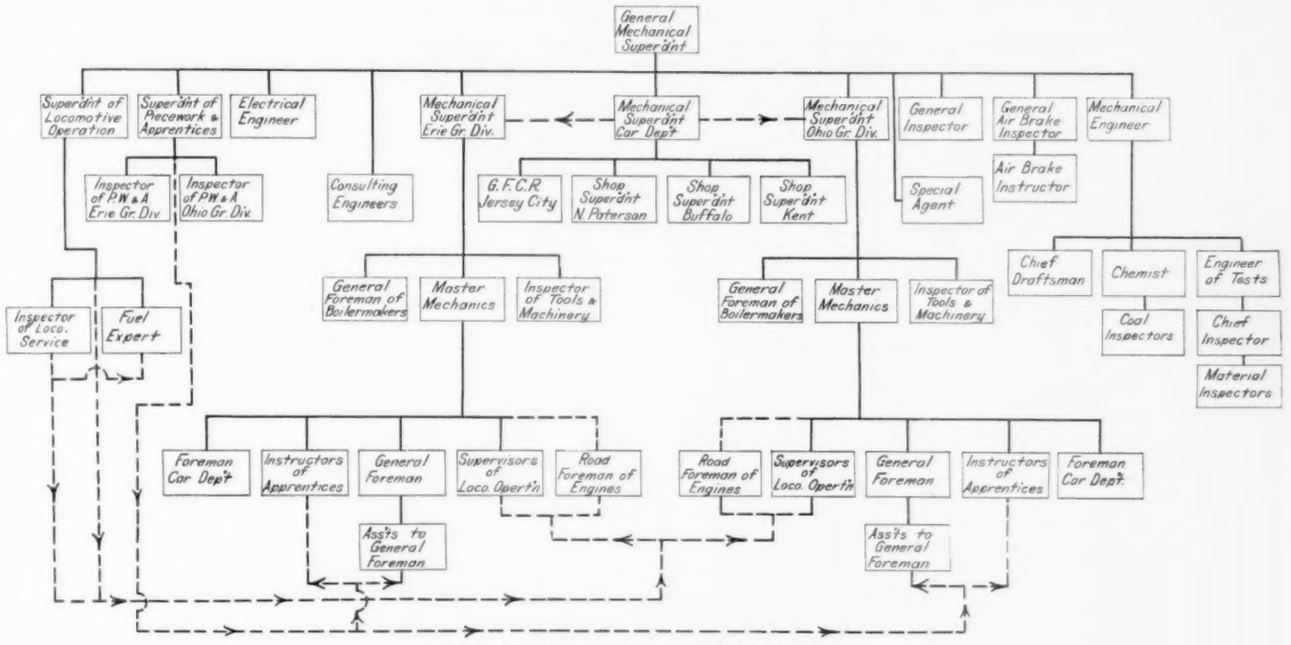
Railroads in Winter.—It has been often urged as an objection against railroads that they cannot be kept open in winter in consequence of the obstructions occasioned by great falls of snow. As if to furnish a satisfactory experiment on this point, it has so happened that the present winter has been of unusual severity and the quantity of snow which has fallen has probably been greater than has been known for many years. It is therefore, with great pleasure that we understand that scarcely any interruptions in the travel upon the railroads leading from this city have taken place and that the practicability of keeping them open during the severest winter has been satisfactorily established.—*From the American Railroad Journal, February* 20, 1836.

# MECHANICAL DEPARTMENT ORGANIZATION OF THE ERIE

BY R. S. MOUNCE

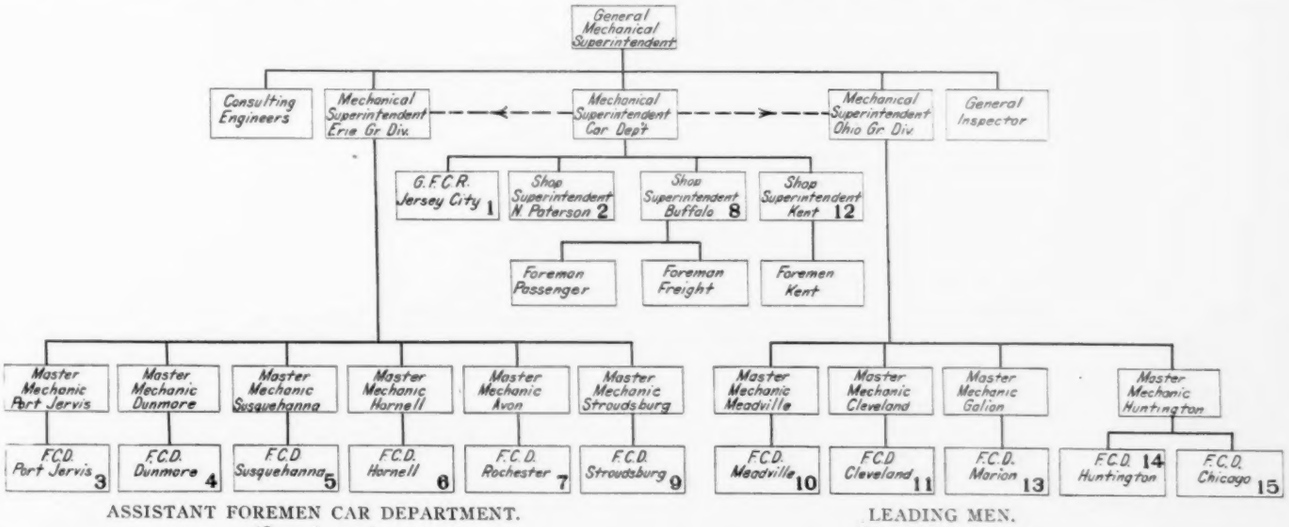
During the past year many changes have been made in the mechanical department organization of the Erie Railroad, and most of them have been in effect long enough to clearly indicate that they were wisely made. The accompanying diagrams show the present organization, the entire mechanical department having the general mechanical superintendent at its head. There are two grand divisions of the locomotive department, each in charge of a mechanical superintendent, and the organization of the Erie Grand division, which is representative, is given. The car department is in charge of a mechanical superintendent. The following officers report directly to the general mechanical superintendent: Three mechanical superintendents; superintendent of locomotive operation; superintendent of piece work and apprentices; mechanical engineer; electrical engineer; general air brake inspector; general inspector; consulting engineers, and special agent.

The two grand divisions of the locomotive department are




Note.—Dotted lines indicate divided jurisdiction.

**Organization of the Mechanical Department of the Erie.**




ASSISTANT FOREMEN CAR DEPARTMENT.
(Over 5 men.)

1—Has jurisdiction over Penhorn, Weehawken, Paterson, Great Notch.
2—Has jurisdiction over Coalburg, Edgewater, Little Ferry.
3—Has jurisdiction over Lackawaxen, Deposit, Middletown, Greycourt, Campbell Hall, Newburg.
4—Has jurisdiction over Avoca, Jessup, Hawley, Honesdale.
5—Has jurisdiction over Carbondale, Forest City, Binghamton, Owego, Waverly, Elmira, Blossburg, Corning, Addison.
6—Has jurisdiction over Wellsville, Olean, Salamanca, Bradford, Johnsonburg, Brockwayville.
7—Has jurisdiction over Avon, Bath and Hammondsport.

LEADING MEN.
(Over 5 men or less.)

8—Has jurisdiction over East Buffalo, Erie Dock, Susp. Bridge, N. Tonawanda, Black Rock, Attica, Dayton, Silver Springs.
9—Has jurisdiction over Beaver Lake, Moosic, Pocono St.
10—Has jurisdiction over Jamestown, Shenango, Oil City, Corry.
11—Has jurisdiction over Randall, Phalanx, Brier Hill, Ferrona, Niles, Lisbon, New Castle.
12—Has jurisdiction over Akron, Creston, Sterling.
13—Has jurisdiction over Dayton, Mansfield, Maitland, Urbana, Durbin.
14—Has jurisdiction over Lima, Ohio City, Decatur, Kingsland, Bolivar, Rochester, De Long, N. Judson, Griffith, Kenton.
15—Has jurisdiction over Hammond.

Note.—Dotted lines indicate divided jurisdiction.

**Organization of the Car Department.**

the Erie, or eastern section, and the Ohio, or western section, each in charge of a mechanical superintendent, the first with headquarters at Jersey City, N. J., and the second at Cleveland, Ohio. Reporting to each mechanical superintendent are a general foreman of boilermakers, an inspector of tools and machinery, and the several division master mechanics. The first of these staff officers has jurisdiction over all matters pertaining to boiler work, and the second has to see that all tools are maintained according to the road's standards and also has charge of the installation of machine tools, boilers and other such details.

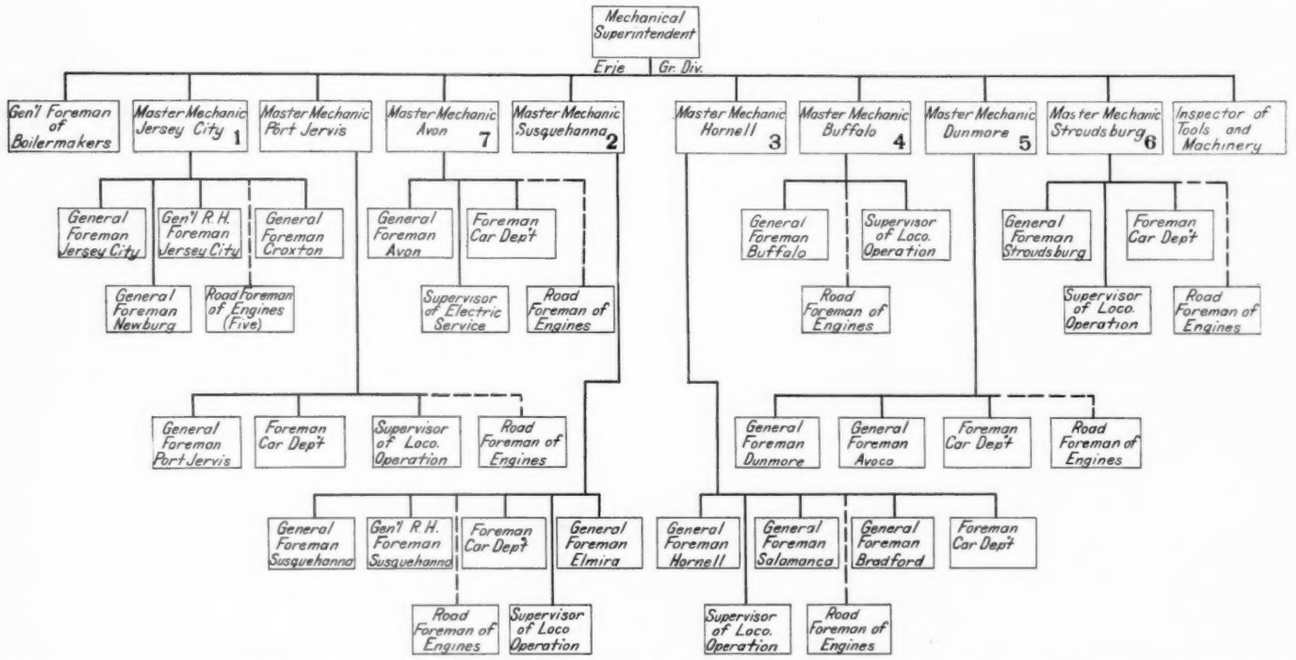
The mechanical superintendent in charge of the car department, whose headquarters are at Meadville, Pa., has complete and direct jurisdiction over the three shops where all the heavy car repairs are made, namely, North Paterson (passenger car repairs), Kent and Buffalo (freight and passenger car repairs), each of which is in charge of a shop superintendent; also over the general foreman of car repairs at Jersey City, who has charge of all the terminal passenger car work and that at the outlying points in the commuter territory, as well as the freight car work in this territory. The head of the department has charge of the minor car repair points through the heads of the locomotive department, or in other words, the foremen of the car department report directly to the master mechanics, and all instructions issued by the car department head are transmitted to them through the mechanical superintendents in charge of the locomotive department. This divided jurisdiction is shown by the dotted lines on the diagrams.

The superintendent of locomotive operation has direct jurisdiction over the inspector of locomotive service and the fuel expert, and the former have indirect jurisdiction over the supervisors of locomotive operation and the road foremen of engines. The supervisors of locomotive operation report directly to the master mechanics and their duties are principally along the lines of fuel economy, lubrication, tools and other supplies; the road foremen of engines, who are essentially in the operating department, report to the master mechanics on matters relating to the maintenance of locomotives. The fuel expert reports to the inspector of locomotive service as well as to the superintendent of locomotive operation. The coal inspectors are under the jurisdiction of the chemist, who reports to the superintendent of locomotive operation on fuel matters. This constitutes the fuel economy organization and it closely connects the mechanical and operating departments, thereby insuring the best results through proper co-operation.

The superintendent of piece work and apprentices has indirect jurisdiction over the assistants to the general foremen and the instructors of apprentices, who are on the master mechanics' staffs. The assistants to the general foremen look after the piece work at the several shops, and the instructors of apprentices are in charge of the technical and practical instruction of apprentices at the shops where apprentice schools have been established.

The mechanical engineer is located at Meadville. His staff includes the chief draftsman, chemist, engineer of tests and all material and coal inspectors. The electrical engineer looks after all electrical matters, including shop power installation and the electric lighting of passenger cars. The duties of the general air brake inspector are fully explained by his title. The general inspector has charge of all car department inspection and it is among his duties to see that all inspectors of new equipment are conversant with the standards and details called for by the specifications. The consulting engineers are car experts. The special agent is in charge of the details in connection with making improvements to insure safe working conditions at the several locomotive and car shops. He also keeps in touch with legislation concerning mechanical department matters in order to make sure that the requirements are strictly adhered to.

Since this reorganization has been in effect, marked improvements in the efficiency of the department as a whole have been manifest, fully warranting the many changes that were made.




1—Has jurisdiction over Waldwick, Suffern, Paterson, Nyack, Campbell Hall, Weehawken, Midvale, West Orange, Caldwell, Little Falls, Harriman, Goshen, Pine Bush, Newark, 28th St., Sterling Forest, Greycourt, N. J. & N. Y.
2—Has jurisdiction over Blossburg, Binghamton, Corning, Waverly.
3—Has jurisdiction over Dunkirk, Olean, Brockwayville, Johnsonburg.
4—Has jurisdiction over Attica, Castile, Tonawanda, Susp. Bridge, Gowanda, Dayton, Black Rock.
5—Has jurisdiction over Hawley, Lackawaxen.
6—Has jurisdiction over Yatesville, Lodi, Passaic, Wortendyke, Butler, Beaver Lake, Middltown, Blairstown, Moosic, Edgewater, N. Paterson.
7—Has jurisdiction over Rochester, Bath and Hammondsport.

Note.—Dotted lines indicate divided jurisdiction.

**Organization of the Locomotive Department on the Erie Grand Division.**

# FORMULA FOR SADDLE PIN OFFSET

All who have had anything to do with the designing and setting of the Stevenson link motion are familiar with the extreme sensitiveness of the valve events to any change in any of the parts composing the gear, from the connecting rod to the location of the lifting shaft. A change in the length or point of suspension of any element will have its effect on the motion of the valve, and this effect, being usually a bad one, calls for a modification of some or all of the other parts. To work this out on the drawing board is a slow process, and the usual method of securing a fair equalization of cut-off is to lay out the valve gear on the drawing board to general proportions and arrangement best suited to the design of the engine and then correct inequalities by erecting it on the locomotive and securing the equalization of the cut-off and the valve events by using an adjustable link saddle, whereby the offset of the saddle pin can be set in that position to secure the best movement of the valve.

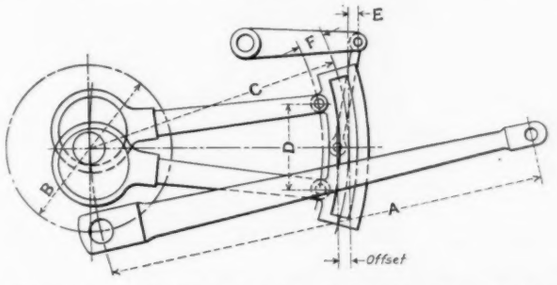



Diagram of Stephenson Valve Gear with Open Rods.

The regular saddle is then made, with the pin offset to correspond to that obtained, and is applied to the link. In short, the errors of design are corrected by the offset of the saddle pin.

As there was no formula by which this offset could be calculated for any given arrangement and proportion of the parts, O. W. Young, in charge of the valve designing for the American Locomotive Company, undertook to solve the problem and obtain, if possible, a formula by which the saddle pin offset could be calculated.

For this purpose he used the valve gear model at Schenectady, and set up, as a base gear, one having the following dimensions, as shown in the accompanying illustration:

| | |
|---|---|
| Length of connecting rod = (*A*) | 96 in. |
| Stroke of piston = diameter of crank = (*B*) | 24 " |
| Radius of link = (*C*) | 48 " |
| Distance between points of attachment of eccentric rods to link = (D) | 12 " |
| Distance from point of support of link hanger to center of link = (*E*) | ½ " |

This provided for all of the dimensions shown except *F*, the distance of the points of attachment of the eccentric rods from the center line of the link, the saddle pin offset, and the throw of the eccentric. With these general dimensions of the gear, he proceeded to find the saddle pin offset for different dimensions of *F*, varying by ¼ in. increments from 1¾ in. to 4 in. with open and crossed eccentric rods, and with eccentric throws of 5 in. and 6 in. The results of these trials are given in the accompanying diagram:

For example, suppose we have a gear like that used for the base, where open eccentric rods are used, the throw of the eccentric is 5 in. and *F* equals 3 in. Then the vertical line at which the diagonal for open rods, for the 5-in. eccentric throw crosses the horizontal line from *F* equals 3 will indicate the saddle pin offset, which, in this case, is ⅝ in. Then ⅝ in. becomes the base figure for all gears having an eccentric throw of 5 in. and a distance *F* equal to 3 in. The formula is purely empirical, and is based on experimental observations extending through many months in which all possible combinations of dimensions were used. The result of these observations was the development of the following rules:

FOR OPEN RODS.

For each 12 in. added to the dimension *A*, 1/16 in. should be added to the offset.

For each 2 in. added to dimension *B*, 1/32 in. is to be subtracted from the offset.

For each 12 in. added to dimension *C*, 1/16 in. is to be subtracted from the offset.

For each 1 in. added to dimensions *D*, ¼ in. is to be subtracted from the offset.

When *E* = *O*, add 1/16 in. to the offset.

FOR CROSSED RODS.

For each 12 in. added to dimension *A*, ⅛ in. is to be added to the offset.

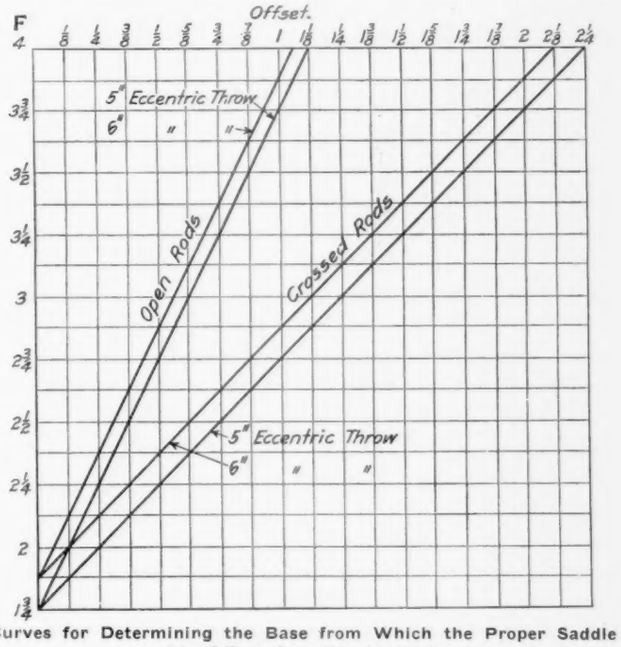
For each 2 in. added to dimension *B*, 1/16 in. is to be subtracted from the offset.

For each 12 in. added to dimension *C*, ⅛ in. is to be subtracted from the offset.

For each 1 in. added to dimension *D*, ¼ in. is to be subtracted from the offset.

When *E* = *O*, add ⅛ in. to the offset.

The application of these rules can be best shown by a specific




Curves for Determining the Base from Which the Proper Saddle Pin Offset Can Be obtained.

example. Suppose, then, a valve gear has been designed, in which

*A* = Length of connecting rod = 108 in.

*B* = Crank diameter = 26 in.

*C* = Radius of link = 60 in.

*D* = Eccentric rod pin spacing = 13 in.

*E* = Distance of link hanger pin from center of link = 0 in.

The eccentric rods are open and the eccentric throw is 5 in. Then, as before, the base figure is ⅝ in.

For *A*, we have 108 — 96 = 12 in.; giving 1/16 in. to add.

For *B*, 26 — 24 = 2 in.; giving 1/32 in. to subtract.

For *C*, 60 — 48 = 12 in.; giving 1/16 in. to subtract.

For *D*, 13 — 12 = 1 in.; giving ¼ in. to subtract.

For *E* = *O*, we have 1/16 in. to add.

The solution then becomes:

⅝ + 1/16 — 1/32 — 1/16 — ¼ + 1/16 = 13/32 in.

The proper offset for the saddle pin is, therefore, 13/32 in.

For open eccentric rods if the offset is too much, the cut-off

will occur later at the front end of the cylinder rather than at the back; while, for crossed rods, too great an offset will give a greater cut-off at the back than at the front.

It is not claimed for these rules that the results will be the best attainable, but that they can be implicitly followed in a design and the engine will be square and perfectly satisfactory in its operation. It has been used repeatedly on what might be called freak gears, where, to the casual observer, the offset would appear normal, and the result has been satisfactory. Its promulgation is certainly of great value, and it will be found to be especially useful where engines are out of square and need a readjustment of their valve events.

## SERVICE OF VANADIUM STEEL LOCOMOTIVE PARTS

Extended service tests of heat treated chrome-vanadium steel parts on large locomotives are showing this material to have decided advantages, both as regards strength and wearing quality. In addition to springs, frames, axles and piston rods, main rods and tires of this material are shown by recent reports to possess distinct and practical advantages.

In regard to main and side rods, the experience of several of the lines of the New York Central System is interesting. On the Michigan Central a comparison between the percentage of failures of vanadium rods on consolidation and Pacific type locomotives, built since 1910 and the failures of carbon steel rods on the same classes of engines built since 1906, taking into consideration in the latter case only those failures which occurred within a period of three years service or less, shows that the chrome-vanadium steel reduced the failures by over 80 per cent. The comparison includes 90 locomotives equipped with vanadium rods and 84 equipped with carbon steel rods. Of the former there have been but three failures or 6-tenths of 1 per cent. of the total. All of these were side rods. The failure of carbon steel rods in the same length of time amounted to 3⅓ per cent. and in the case of one lot of locomotives built in 1907, the failure of carbon rods in three years amounted to 10 per cent. Very similar results have also been given on the Lake Shore & Michigan Southern, the Lake Erie & Western, the Chicago, Indiana & Southern and the New York Central & Hudson River. Summarizing the records of all five of these roads it is found that out of a total of 757 road engines equipped with vanadium steel rods since 1910, the total number of rod failures to date amounted to only ¾ of 1 per cent. Most of these occurred on the earlier applications and appeared to be largely due to the fact that the locomotive builders at that time did not possess the heat treating equipment that they now use. The later rods were subjected to a double heat treatment with very noticeable improvement.

Last fall about 40 of the railroads of the country ordered heat treated, chrome-vanadium steel tires with a view to testing the wearing qualities as compared with ordinary carbon steel tires. These tires were made to the latest approved specifications based on data secured from extensive experiments and research carried on jointly by the tire makers and the American Vanadium Company. Contours of all the tires installed are being periodically taken by the American Vanadium Company's inspectors and careful record is kept of their performance.

Among the first tires to be applied there were some on locomotives running on the Chicago Junction Railway. Owing to the exceptionally short curves in the stock yards in Chicago, there are few roads in the country where switching conditions are harder on the tires than on this one. While none of these tires have been in service long enough to show ultimate results, progress service reports of those first applied present some interesting comparisons. An example is a six wheel switching locomotive to which the heat treated chrome-vanadium tires were applied on December 3, 1912. This engine has a total weight in working order of 142,500 lbs. It has 20 in. x 26 in. cylinders and 51 in. diameter wheels. A new set of carbon steel tires were applied at practically the same time to a sister engine working in identical service.

Contours taken of the tires with a tire contour machine in October, after 10 months service showed a maximum tread wear of 7/32 in. with a minimum of 3/16 in. on the chrome-vanadium tires. The flanges were in excellent condition. The carbon steel tires were applied on December 27, 1912 and on September 10, after about 10 months service they had to be turned. At that time they showed a maximum tread wear of ½-in. and had made 34,570 constructive miles, figured on the railway company's basis. The vanadium tires had made 32,750 miles. This gives 9,360 miles for 1/16 in. of tread wear on the vanadium tires and 4,320 miles per 1/16 in. wear with carbon tires. The carbon tires had to be turned to 50⅜ in. diameter which represented a ⅝ in. loss in thickness of metal from wear and turning and gives only 3,475 miles for 1/16 in. total loss in thickness after the first turning.

The vanadium tires were made at the Latrobe Works of the Railway Steel Spring Company to the chemical and physical specifications prepared by the American Vanadium Company. They were subjected to a very careful heat treatment.

## STANDARD GAGE TRACKS THROUGH SHOP BUILDINGS

BY PAUL R. DUFFEY

In building new shops or additions to old ones it is a great mistake to make no provision for a standard gage track from end to end of the center section. Such a track will permit the yard crane or wrecking crane to enter and unload any heavy machinery, as well as to place it on the foundations. Many large machine and smith shops are without this feature and when such machines as large steam hammers, bolt headers, punches and shears, wheel lathes, planers, etc., have to be installed and assembled by hand much money and labor is expended which might have been avoided by a little more foresight.

Not long ago a very large steam hammer was to be installed in a fair sized smith shop, and the nearest track available for unloading the parts of the hammer was so close to the machine shop that a crane could not turn more than two feet without striking the shop wall. It was therefore necessary to unload the parts about 120 feet from the foundation in the smith shop, which necessitated skidding and rolling the various parts, some weighing over ten tons, over the entire distance. Such work requires considerable time as well as skill in manipulating the parts to keep them from upsetting. The time consumed in setting up this machine with one machinist and from three to seven helpers was about twelve days, whereas if there had been a track through the shop the crane could have handled the work in about two days, with an estimated saving of at least $60. Such cases arise at some time almost everywhere and if such a track were installed, even if only used a few times a year, it would be a paying investment.

Charleston & Cincinnati Railroad.—We are highly gratified to learn that the Legislature of Kentucky has adopted an enlarged and liberal policy in relation to the Charleston & Cincinnati Railroad. Let the people build railroads where they will and if necessary aid them in all great national works.—*From the American Railroad Journal, February* 13, 1836.

Monopoly in 1836.—Our New Jersey friends, notwithstanding their dread of monopoly, and in particular, of the Camden & Amboy Railroad and Delaware and Raritan Canal, have determined by their representatives in State Legislature assembled, not to abate the nuisance; in other words, the "proposition" of the united companies to sell out to the state has been rejected.—*From the American Railroad Journal, February* 20, 1836.

# CAR DEPARTMENT

## FREIGHT CARS DAMAGED BY IMPROPER LOADING

A statement regarding the damage caused to the doors, etc., of freight equipment by the cars being improperly loaded has been issued by the Niagara Frontier Car Inspection Association. This statement covers several thousand cars and includes photographs and statements in detail as to the condition in which a large number of them were found. It is signed by J. C. Fritts, master car builder, Delaware, Lackawanna & Western; T. J. O'Donnell, arbitrator, Niagara Frontier Inspection Association, and W. H. Sitterly (chairman), general car inspector, Pennsylvania Railroad, and is as follows:

"We feel that the manner in which loads are placed in box cars at the loading points is responsible in a large measure for the condition of the box car doors and fastenings. No regard or respect is given the Master Car Builders' Association Loading Rules, and we believe that the situation should be canvassed thoroughly and that the superintendent or the agent having jurisdiction where closed cars are loaded should instruct the shipper in the proper method of loading and use his best efforts without antagonizing the shipper to induce him to place the proper means of securing the load in the car to prevent its coming in contact with the side doors. This will result in cutting down the large expense incurred, reduce the number of cars now being placed on shop tracks for repairs, and insure the lading reaching its destination at an earlier date than it now does, with consequent satisfaction to the shipper.

"A careful check of several thousand cars set out to have loads adjusted indicates that 70 per cent. of the total number was on account of lading being against the side doors, which in many cases were pushed completely off of their fastenings, resulting in more or less damage. It is believed that the question of bad loading has more to do with defective side doors than any other one item. It was, therefore, resolved at this meeting that the attention of the General Managers' Association be called to this condition through the heads of our various mechanical departments with a view of obtaining concerted action on all roads throughout the country, not only in educating the shippers, but the agents as well.

"In addition to the large expense incurred and the delay to freight, the most important feature of the defective door is the liability of serious accident due to doors and lading falling on adjacent tracks, and it is felt that all of the annoyance and trouble complained of could be reduced to a minimum, provided the necessary attention is given at the initial point of loading. It should be understood that the mechanical department will take the necessary steps to place the doors and fastenings in good condition, co-operating with the traffic department to bring about the desired results in this respect.

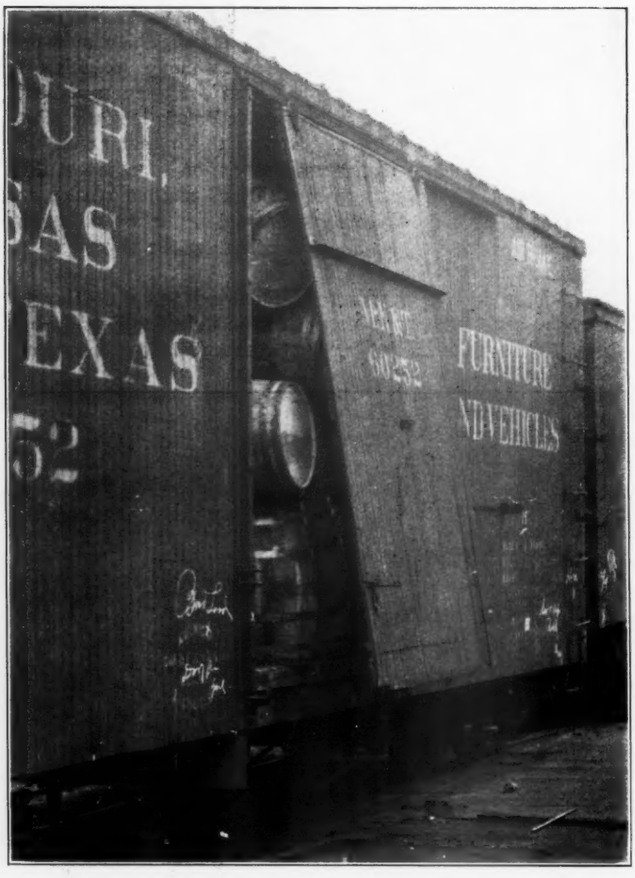
"We further feel that it would be well to have a representative from the mechanical department meet with the superintendent and the agents at the agents' meetings to take up the proper interpretation of the loading rules and to educate the agents as to what is necessary in the line of protecting the different kinds of commodities loaded in closed cars. Agents should have impressed upon them the importance of this as well as the serious conditions that exist in many instances on account of

A Shipment of Pulpwood Shifted at the Doorway for Lack of Proper Protection.

The Effect of a Lack of Doorway Protection on a Shipment of Feed in Bags.

the non-compliance with the Master Car Builders' rules.

"In the Niagara Frontier Inspection district, comprising thirteen roads, the monthly average number of cars that require switching from the yard to the transfer tracks and repair tracks to have the lading adjusted because of negligence in providing proper




**Door Burst Open by the Shifting of a Shipment of Barrels.**

blocking is 8,000. This not only delays the freight but is an extra expense both in switching and adjusting the loads, as well as in maintenance. The condition seems to be becoming worse rather than better."

## DEVELOPMENT OF STEEL PASSENGER EQUIPMENT

While the extensive use of metal for passenger train car construction was considered as early as 1854, it was not until about 40 years later that it began to receive serious consideration. According to a committee on Steel Passenger Cars, which reported at the 1908 meeting of the Master Car Builders' Association, the most important reasons which brought the desirability of introducing steel passenger cars prominently before the railways were:

(1) The burning of wooden cars in wrecks, and the frequent destruction of human life by fire.

(2) The splintering of the large wooden sills, etc., when the cars were wrecked, causing injury and death.

(3) The scarcity of lumber suitable for sills, stringers, etc., and the threatened exhaustion of such material.

(4) In collision with steel freight cars, which were being introduced in great numbers, the passenger equipment was more liable to destruction than was the case with the wooden freight cars.

(5) Increased speeds, greater train lengths, and larger capacity cars.

Then too, the rapidly increasing use of electric motor cars in subway and elevated service, where the passengers cannot easily leave the cars in case of accident, and the danger from fire where electric power is used, suggested the use of non-inflammable materials in the construction of these cars. This was undoubtedly largely responsible for the development of the all-steel passenger train car.

The movement received its great impetus in the East because of the electrification of the steam roads entering New York City and the possible dangers if wooden equipment were to be used in connection with the use of electric power in the long tunnels. In the West, on the Harriman Lines, steel cars were introduced because of the belief that they would not only prove safer but also that they would be more economical to maintain than wooden equipment.

The publicity departments of the roads which first started to introduce the steel equipment were not slow to realize the advertising value of having all-steel cars on their limited trains and this undoubtedly had some considerable influence in inducing the other roads, particularly those in competitive territory, to adopt such equipment for their better class trains.

The steel frame, side door suburban cars used by the Illinois Central to handle the World's Fair traffic in 1893 are generally regarded as the forerunners of the all-steel passenger car in this country. In the same year the Pressed Steel Car Company built 35 steel underframe cars for the Northwestern Elevated of Chicago. Then followed a steel frame car for the Interborough Rapid Transit Company of New York, a steel car on the Second Avenue Elevated Line in 1904, and the building of 300 all-steel cars for the New York subway in the same year. A steel baggage car was put in service on the Erie in 1904. In the winter of 1904-5 the Long Island introduced 134 steel suburban cars in its electric service, and the Erie added a steel postal car and a steel express car to its equipment. In 1906 the New York Central put in service 125 steel motor cars (these were the first cars built of steel along the lines of a modern steel coach), the New Haven two steel postal cars, the Long Island an all-steel passenger coach, while both the Pennsylvania and the Southern Pacific built experimental all-steel passenger coaches for through traffic. The Pennsylvania also introduced a steel baggage car late in the year.

The year 1907 marked the introduction of a steel postal car on the Southern Pacific, the building of a steel Pullman car, 40 steel passenger cars for the Hudson & Manhattan, a steel postal car and a passenger coach on the Union Pacific, five steel postal cars and a steel passenger car on the Pennsylvania, and 50 more all-steel cars for the Interborough.

The M. C. B. report at the 1908 convention showed that there were about 380 all-steel cars in service or under construction for steam roads at that time, and commented on the fact that the greatest development was shown in the East because of the desirability of having fireproof cars for use on the electrified portions of the roads entering New York City, with their long tunnels. By January 1, 1909, there were 629 all-steel and 673 steel underframe cars in service in this country, and on January 1, 1913, there were 7,271 all-steel cars and 3,296 steel underframe cars.—*Railway Age Gazette.*

LARGEST MARINE TURBINES.—A start has been made at Clydebank with the work of putting the turbines on board the new Cunard line steamer *Aquitania*. The total weight of these turbines is 1,400 tons. To enable them to be lowered into the hull of the ship one of the four funnels was not placed in position. The low pressure turbines are the largest ever constructed, each weighing about 425 tons. There are over a million turbine blades, which, if placed end to end, would reach over 140 miles.—*The Engineer.*

# STEEL FRAMING FOR BOX CARS*

## Development and Service of This Type; Necessity of Well Selected Lumber for Sheathing.

BY R. W. BURNETT,
General Master Car Builder, Canadian Pacific, Montreal, Que.

This paper deals with the superstructure details of the steel frame box car and the information and data presented are based on the writer's experience on the Canadian Pacific system with the design, construction and maintenance of 30,000 cars of this type, which represent an investment of $30,000,000.

Credit is due to C. A. Seley, formerly mechanical engineer of the Rock Island Lines, for designing the first outside sheathed steel superstructure box cars that were constructed in large numbers. The introduction of steel into the superstructure of the box car, and the development of the outside sheathed steel superstructure in particular, were discussed so thoroughly by Mr. Seley in his comprehensive paper before the Franklin Institute in January, 1910, that I have thought it unnecessary to go over this same ground, but will review only briefly the development of the box car from the all-wood car through the intermediate stages of steel underframe cars.

The original wooden car, with the single spring draft rigging having the cheek castings bolted to the sills, gave little if any more trouble than modern equipment, due principally to the shorter trains, less density of traffic and to the use of link and pin couplers which compelled gentler handling of trains than is prevalent today. The steel underframe car was built mainly to secure a stronger center construction for the attachment of draft rigging and to get away from the trouble caused by wooden sills breaking and splitting, broken draft bolts, etc.

While having many advantages over the old wooden car, the steel underframe car developed some troubles peculiar to itself, the most important being due to the fact that the body being carried on a rigid frame and not held together by the strains resulting from its weight, as in the old trussed cars, has a tendency to develop slack in the superstructure. This in turn affects the roof and sheathing. One principal trouble with outside sheathed cars is that, after they have been in service a comparatively short time, the sheathing frequently loosens at the end sill and at the side sills near the bolsters with resultant leakage of grain.

There were some steel frame box cars built previous to 1909, but the writer has been able to secure data on only the outside sheathed types. Of these 2,700 were in service on the Norfolk & Western, of which the first 100 were built in 1902; the owners state that they were satisfactory and the same type has been purchased on subsequent orders. The Rock Island and Frisco lines had in service at that date approximately 5,000 cars similar to the Norfolk & Western, and these also appear to have given satisfaction as the owners have reordered the same type several times. All of these, however, were outside sheathed and as regards leakage at the sills, had comparatively little advantage over the wooden cars. Recently both of these lines have purchased some inside sheathed cars. The Frisco car of this type is fully described in the *Railway Age Gazette*, October 3, 1913, and in the *Railway Age Gazette, Mechanical Edition*, October, 1913, p. 555.

**Canadian Pacific Steel Frame Box Car with Corrugated Metal Sheathing.**

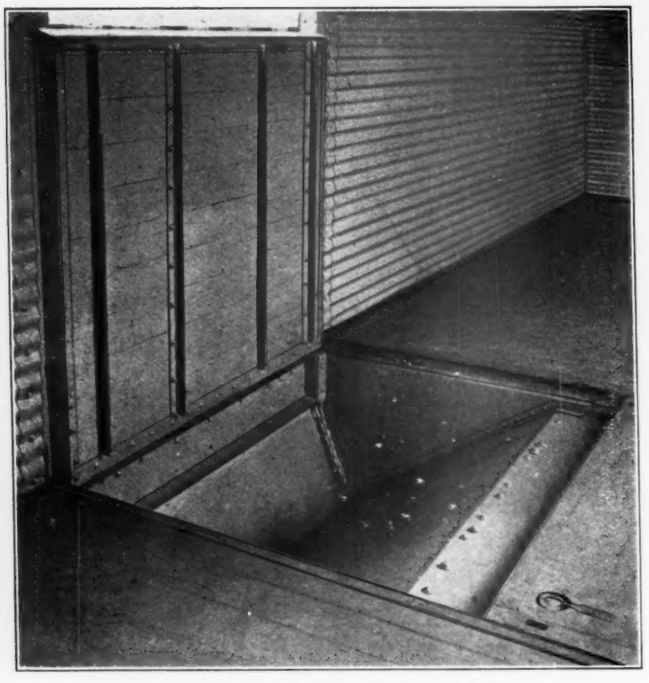
In 1908 the Canadian Pacific designed its first steel frame inside sheathed box car. This car avoided the disadvantage of the outside sheathed car, something which had not been accomplished by the steel frame cars constructed up to that time, and at once obtained a further reduction in weight and provided for cheapness of maintenance by the use of steel superstructure,

*A paper read before the American Society of Mechanical Engineers at the annual meeting, December 3, 1913.

without the additional lumber required by the outside sheathed car. With practically no preliminary experimenting 500 of these cars were built, and since then over 30,000 have been built similar to the first cars, with the exception of several refinements of details, such as corner and door posts, end doors and side plates, and the joining of flooring and lining. These changes have not affected the general design of the car, but are the improvements that have been introduced from time to time to reduce weight and simplify the construction.

ADVANTAGES OF THE STEEL FRAME CAR.

The steel frame inside sheathed car has several advantages over the types previously used, notably in that the tare is low in proportion to the capacity. There is such a variation in the figures used for the cost of hauling per ton mile, that no attempt is made to say what the saving would amount to, but certainly the advantage of having a car equal, if not superior to other cars in all respects, and weighing from 1,000 to 5,000 lbs. less, will appeal to all traffic and operating men. Not only is there that much less dead weight to haul when the car is empty or partly loaded, but additional lading can frequently be carried. The actual limit on the paying load that can be carried in a properly designed car is the total weight on the axles. Thus, a car having 5 in. x 9 in. axles with such a tare weight that, when deducted from the capacity of the axles, allows the car to be safely loaded to 88,000 lbs. could, if dead weight be reduced by 3,000 lbs. safely carry a paying load of 91,000 lbs. and retain the same strength. Thus the actual capacity of the car is increased almost 4 per cent., with a better ratio of paying to dead load.

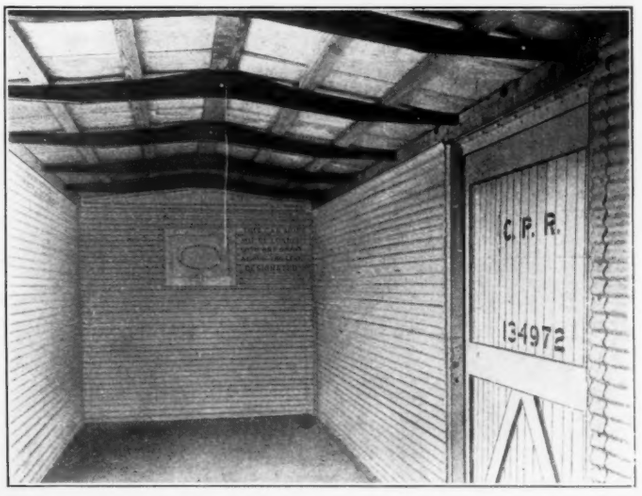


Hopper Bottom in Connection with Metal Sheathing.

It had been thought necessary to assist the wooden type of superstructure by heavy roof construction, some going so far as to use different methods of diagonal bracing, but with the steel car it has been found that there is no appreciable local movement of the framing in the heaviest service which makes a simple proposition of the roof as it has only to take care of itself. This presents a simpler problem to roof designers, making it possible to design a roof much lighter, without necessity for the use of purlins or ridge poles to strengthen the car. It is obvious that unnecessary weight in the roof raises the center of gravity, increases the tare weight and cost and has other disadvantages.

In explanation of the local movement of this style of framing, it is well to mention tests we have made in jacking up this type of car, which demonstrated that the car would take a gentle twist from end to end, allowing the bolsters to be slightly out of the same plane horizontally. This twisting was accomplished without any perceptible local distortion of the sides or ends. The capacity for twisting is a condition to be desired as it allows a car to adjust itself to uneven track conditions.

In addition to being 5½ in. narrower than the distance over the outside of the sheathing of a wooden car, the superstructure of the Canadian Pacific car is protected by the framing, so that a side swipe that would do serious damage to an outside sheathed car frequently does not touch the lining and is resisted by the framing without damage to the posts or braces. Frequently it is found that a side swipe that would almost demolish the sides of a wooden car only bends the steel framing, and in making repairs, the lining is merely removed, posts and braces straightened and the original lining replaced, the whole cost being the comparatively small labor charge. Jacking frames are being installed at all of our principal repair points for all classes of steel cars, and while not original with the Canadian Pacific, they have been amplified to better take care of steel frame box cars. With these frames, many jobs that would require the car to be cut apart, taking several days, can be done in a few hours without cutting the rivets. With modern steel frame cars, these jacking frames are as much a necessity as the blacksmith shop or any other part of the shop.




Interior of Canadian Pacific Corrugated Metal Sheathed Box Car.

It is difficult to clean an outside sheathed car properly when it is unloaded, on account of grain lodging between the framework and also on account of the opening where the posts and braces meet at the bottom becoming obstructed, resulting in grain being retained between the sheathing and lining with resultant complaints from shippers. All of this is overcome by the clean joining of the lining and the floor in the steel frame cars, and it is believed a change of this kind would have come years sooner if designers had kept in close touch with service conditions. One advantage of the steel frame car is that outside of possible repairs due to wreck damage and to wear and tear of couplers, wheels, brake shoes and journal bearings, the car does not deteriorate more rapidly in service than when stored.

SELECTION AND TREATMENT OF LUMBER.

The grading of lumber for use in these cars is an item that has received much consideration. Yellow pine or fir has so far been the principal lumber used, although we have experimented

to some extent with spruce, but although it has the advantage of being lighter, it seems to be more difficult to dry spruce sufficiently for this purpose. Great pains have been taken to avoid knots that are too large or numerous and while it is generally desirable to have lumber as free from knots as possible, I have never in the inspection of many hundreds of cars, seen where a knot had fallen out. It is, however, desirable to have lumber as free from sap and shakes as possible and thoroughly dry.

When the first of these cars were built outside of the Canadian Pacific shops we had considerable difficulty in getting the lumber properly dried, due to lack of both experience and facilities on the part of the car companies. We have about 3,000 cars on which the lumber has shrunk and given them a bad appearance, but this result was expected, as when the cars were built the lumber was quite green. The sheathing on these cars could be tightened for less than $4 per car, but very few have been tightened, owing to receipt of practically no reports of loss or damage to lading due to the shrinkage; also as they do not frequently reach our main repair tracks, being shopped only for such repairs as wheels or wreck damage, we have not considered it advisable to shop the cars for a defect which is almost entirely a matter of appearance. The lining shrinks as much in two months of summer weather as it ever will.

The lining should not be matched before drying, as it warps and curls, rendering it difficult to make a tight joint. The rough size of lumber should be at least ¼ in. greater than the finished dimensions. In establishing limits for drying lumber no information or data whatever could be secured, and after experimenting we came to the conclusion that a piece of this lining of full cross-section subjected to a temperature averaging 170 deg. F. for 96 hours should not lose more than 6 per cent. in weight and that lumber represented by samples losing more than 10 per cent. must not be used until further dried.

The variable condition of the lumber when taken from the yard makes it necessary to use careful judgment as to the length of time it should be kept in the kiln. At the Angus shops of the Canadian Pacific this responsibility falls on the wood-mill foreman, whose constant attention to this feature makes him the man best fitted for the purpose. The average moisture loss reported by the test department for lumber used on cars now building at the Angus shops is 5.25 per cent., which shows that we are getting very satisfactory results from the kilns. A number of tests were made last year on lumber taken from the yard. These tests showed a moisture loss of between 25 and 30 per cent., which shows the importance of drying lumber properly. The accompanying form is used for reporting results of tests both at Angus and outside shops.

REPORT OF MOISTURE IN LUMBER FOR LINING BOX CARS.

Built by..... At.....

C. P. R. Equip. Order No..... For..... Number of Cars.....

Report No.....

Moisture determination strictly in accordance with C. P. R. Spec. No. 243 C.
Samples obtained every other day during construction, with a minimum of one sample for each one hundred cars built. Result of each test must be promptly recorded on this sheet and sent to R. W. BURNETT, Gen'l M. C. B., Montreal.

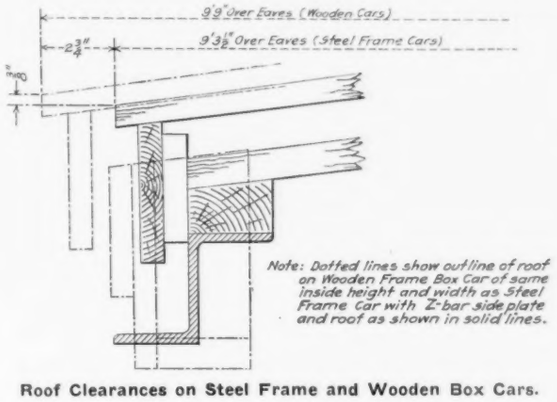
| Lab. No. | Date of Sample | Cars Completed | Car Nos. Represented | Moisture Per Cent | Average To Date | Orig. Width Inches | Shrinkage Inches | Average To Date Inches | REMARKS |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

Signed Engineer of Tests.

FORM USED ON THE CANADIAN PACIFIC FOR REPORTS OF THE MOISTURE DETERMINATION IN LUMBER.

Due largely to our insistence, nearly all of the car plants in the country are now equipped with dry kilns, and any possible additional cost of drying lumber in excess of what has been considered good practice in the past would be less than one dollar per car. Such drying would make the car side practically the same as one board so that it is absurd that the possible shrinkage of lumber should be considered as any reason for this type of car not being built. It has been claimed that lumber can be so dried that it will swell and bulge, but we have never found this to occur. We have had cases where lumber slightly moist has dried more rapidly on the inside, due to that side not being painted, and made the outside of the boards slightly convex, with tight joints that could be easily mistaken for swelling, whereas the opposite is the case. We have kept a car with very green lumber in the passenger car shop under a high temperature for over a month until the lumber was absolutely bone dry, and then put it outside with doors open through four weeks of spring weather, during which it rained almost constantly, with a result that there was no closing of the cracks that could be detected. This further proves that there is nothing to be feared from lumber being too dry.

The defects in the sheathing that must be most closely watched are shakes or splits that extend obliquely downward into the car. These must be knifed in with paste before the car is painted. The edges of the lining should be painted, and we have found this can be done more easily and thoroughly by dipping the boards and putting them through between two rubber scrapers, which removes the surplus paint, leaving the edge thoroughly coated. This gives a thin coat of paint on the inside of the car which is an advantage in causing the lumber to dry more uniformly, and diminishes the tendency to warp. Narrow boards have the advantage of having less tendency to warp, and also if the lumber should not be thoroughly dry, there is less total shrinkage for each board making the space


9'9" Over Eaves (Wooden Cars)
9'3⅝" Over Eaves (Steel Frame Cars)
2¾"
Note: Dotted lines show outline of roof on Wooden Frame Box Car of same inside height and width as Steel Frame Car with Z-bar side plate and roof as shown in solid lines.

**Roof Clearances on Steel Frame and Wooden Box Cars.**

between the edges narrower. The steel work and roofing are painted the same as on other cars. This considerable space has been given to the grading, drying and painting of lumber, as we have found that these factors have required much more attention than everything else in connection with the car.

DEVELOPMENT OF A STANDARD CAR.

The development of the inside sheathed car has been so rapid and the experience with it so uniformly satisfactory, that I feel safe in saying that its introduction in such large numbers on so many roads in so short a time indicates more nearly a tendency toward the adoption of a standard car than has any distinct type of car outside of patented cars for special service. It is certain that there will be no backward movement to a wooden superstructure, and that this car with possible modifications will remain a standard car unless some superior type of car is developed. It is the writer's opinion that no committee will ever develop a car that will be adopted as standard, but that the nearest we will ever get to a standard is what may be developed by one or two persons given a free hand, and the merit of which is so pronounced that it forces itself upon the country.

With the use of structural steel there is less necessity of carrying special parts in stock on account of repairs being largely a question of labor, and it seems that with this type of car the necessity from a repair standpoint for a standard car is decreasing. This is further borne out by the fact that for the 30,000 new cars of this type we have ordered no material for repairs and carry none in stock outside of material common to all cars, except lining; of the lining, our stock amounts to practically nothing. We save out sufficient of the parts from cars destroyed to make up our stock of repair parts, but have found it necessary to use very little of this. There are, of course, many valid reasons why cars should be made to standard inside dimensions and outside clearances.

To look at the matter in another way, the wheels, axles, journal bearings, journal boxes, couplers, brakes, safety appliances, etc., which constitute the removable and perishable parts, are all standard and when it is remembered that nearly all of the remaining parts of the cars are standard rolled shapes which are easily obtained either from the mill or from stock in all principal cities, it is apparent that we now have, in effect, a standard car or at least a car of standard parts. A car of different dimensions would not increase the cost of maintenance as long as standard shapes are used; nor would it if every lot of cars is designed differently, as long as proper strength is maintained, and any change in design would usually be to increase the strength. In other words, to keep a car as close as possible to standard and reduce the cost of maintenance, rolled shapes should be used in preference to pressed shapes where possible.

It is my belief that the people who are urging the adoption of a standard car for maintenance reasons have in mind the remaining wooden cars for the maintenance of which large quantities of timbers and castings have to be kept in stock. It is of vital importance that the parts be standardized if that style of construction were to be continued. It should not be overlooked that in a car constructed with rolled shapes, these parts seldom need renewal, even when the car is wrecked, as they can easily be straightened or formed to the original shape at any car repair point, while wood would have to be replaced and pressed shapes would call for special dies to reform them. With a wooden box car the amount of material necessary to carry in stock and use for repairs increases rapidly with the age of the car, while with a steel frame box car, outside of parts common to all cars, it does not increase.

WIND RESISTANCE.

The wind resistance on the steel frame box cars with inside sheathing is slightly greater than on a smooth outside sheathed car, but on the other hand, it is less than on any ordinary type of stock car. The difference in the effect of wind resistance between box and stock cars has never been great enough to require any distinction between them as to the number of cars that could be hauled in a train of either, and is really a refinement that not even a dynamometer car can detect. A small change in the angle or velocity of the wind, trucks somewhat out of square, etc., affect the haulage of the train too much to enable any satisfactory figure for the difference in the wind resistance of the various types of cars to be determined. There is a certain stretch of track of about 40 miles on the western plains, without a curve and practically level, where high winds are frequent, on which the hauling capacity of locomotives is dependent principally upon the wind, and yet even there it was found practically impossible to distinguish between the wind resistance of stock and box cars. From this, it is evident that the wind resistance of steel frame inside sheathed box cars as compared with outside sheathed cars may properly be ignored.

**End Construction and End Doors of Canadian Pacific Steel Frame Box Cars.**

CORRUGATED STEEL LINING.

In the summer of 1911, we lined a steel frame box car with corrugated steel and found it to be as simple a matter as lining with wood. We lapped and riveted the sheets, which were No. 13 gage, between the door and end, and had the corrugations on the side and end coincide, pressing into special corrugated angles in the corners to break the joints. At the floor, we straightened out about 4 in. of the corrugation and formed of it an angle that rests on the side sill, and on this the ends of the floor boards were superimposed, making a very tight joint. After 18 months of general service this car was brought in and on examination found to be in as good shape as when constructed. It was interesting to note that when inspected,

the paint sealing the joints where the side sheets lapped was in no place seal broken, indicating that there is no material weaving or deflection of the sides. The paint was in perfect condition, there still being some gloss, indicating that in the use of steel there is no disadvantage as far as the painting is concerned. Different methods of lining with steel could be followed, and I am convinced that if experience proves that there is no damage to be feared from heat, cold or sweating, steel lining will be largely used. But, I am also convinced that the use of steel lining with any insulation will never be extensively used, as it adds to the cost and weight without affording any protection to the lading, which is not secured by the wood lining. An advantage of this construction is shown in one of the illustrations in the application of hoppers under the door openings, which were made without alterations to sills or cross bearers.*

### END CONSTRUCTION.

In the end of the car we use two 4 in. Z-bar end posts of 8.2 lbs. per ft., with 1¾ in. lining, which gives good service, but we intend to use on future cars two 5 in. end posts of 11.6 lbs. per ft., with 2⅜ in. lining for a height of 4 ft. and 1¾ in. lining above. This, we feel, will amply protect any lading. If a car gets such rough handling that wheels, rails or similar lading would break through, it is better to have the boards broken than to distort the posts, as the lining can be replaced at any repair track with a minimum expense, while distorted posts would require sending the car to a steel car repair point. The single thickness end lining makes convenient the application of single thickness, grain-tight end doors.

### SERVICE RESULTS.

Out of 30,000 of these cars, 29 have been destroyed. Based on the length of time in service, this would average a loss of approximately one car per 1,000 per year. Of the cars destroyed, 15 were burned and 14 were destroyed in wrecks, 10 cars being destroyed on foreign lines. As the loss of cars by fire is in no way affected by the details of construction, I will eliminate them from the calculations. This then, based on the length of time in service would give about one-half car per 1,000 per year destroyed in wrecks.

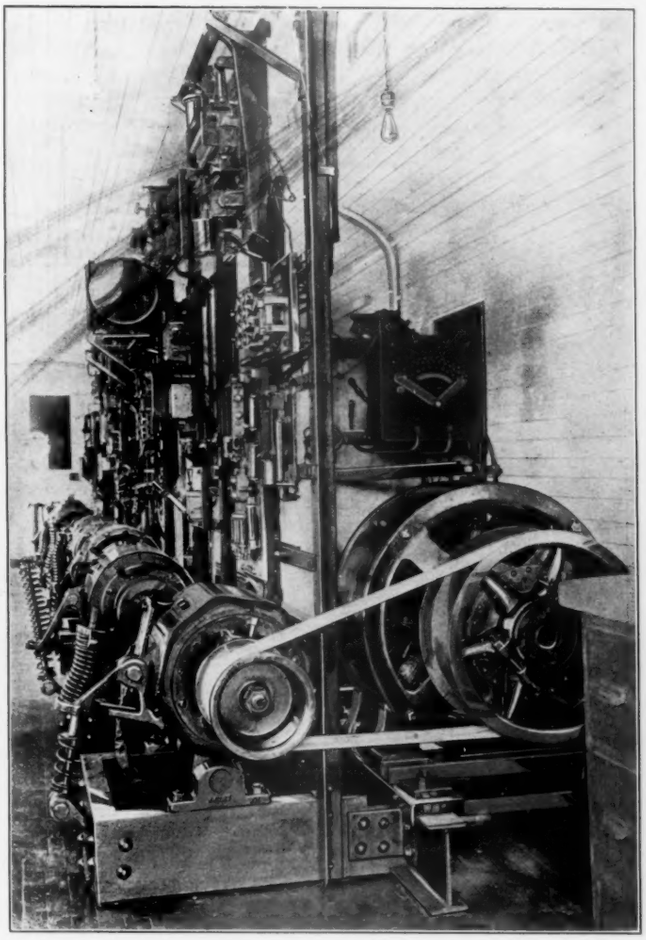
A conservative estimate shows that there are now in service approximately 65,000 steel superstructure cars, including those of the outside sheathed type, and of this number 30,000 belong to the Canadian Pacific.

*For description of Canadian Pacific hopper bottom box car with wood lining see *Railway Age Gazette, Mechanical Edition*, July, 1913, page 386.

## TRAIN LIGHTING INSTRUCTION CAR

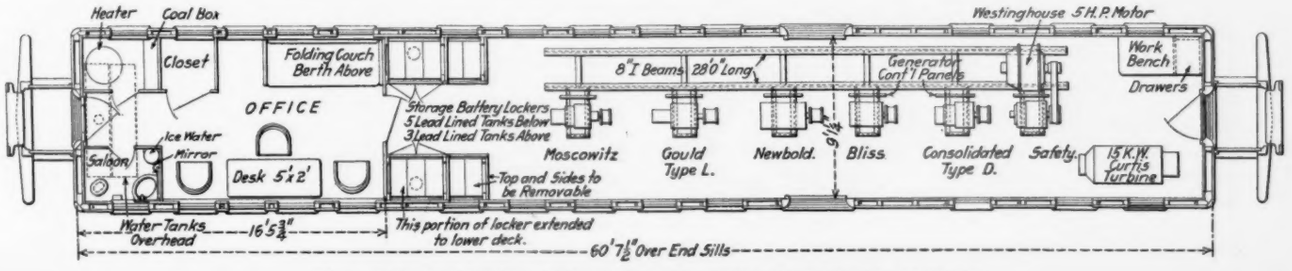
Continuing in its policy of instructing employees in their several lines of duty, the Pennsylvania Railroad has just placed in service a train lighting instruction car. This company has in all at the present time no less than eight distinct axle-driven systems, in addition to the large number of straight storage equipments. The instruction car seems to offer the most efficient means of furnishing uniform instructions to yard electricians and others concerned with the maintenance and operation. The present intention is that the car will be sent to the different points at which electrical forces are maintained, and the men at such points will be given lectures and demonstrations on the operation and maintenance of all the various equipments.

The apparatus installed consists of a 32-cell storage battery, a 15-k.w. Curtis turbo-generator, a variable speed motor with necessary controlling apparatus for driving the axle generators and the following generators with their regulating equipment: Newbold, Moskowitz, Bliss, Safety and Gould. One end of the car has been partitioned off and equipped as an office and sleeping quarters for the instructor. The storage battery is placed within the car in order that the cells may be used in demonstrating as well as for lighting the car; the usual battery boxes under the car are omitted.



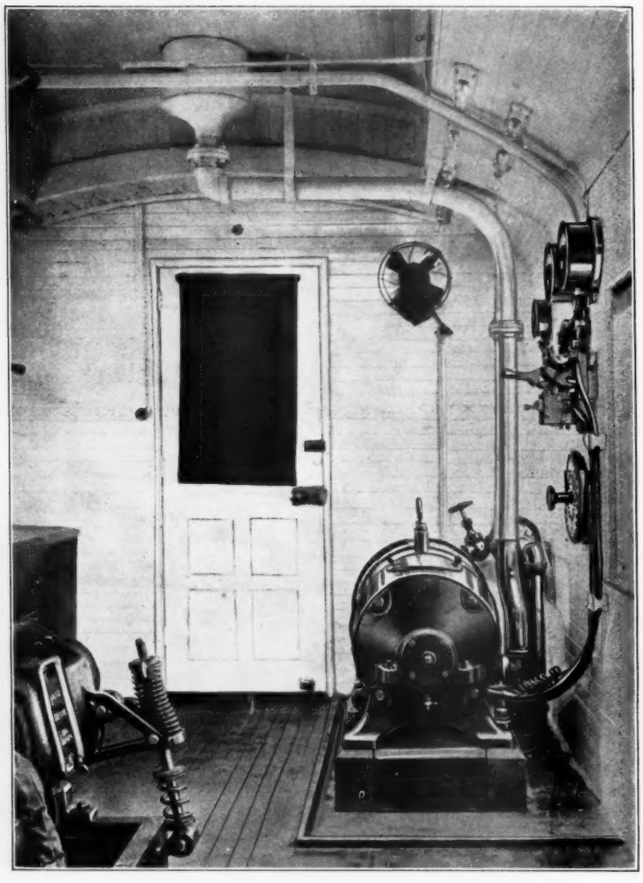
**Arrangement of Axle Driven Equipments in the Instruction Car.**

The compartments for the cells are lined with sheet lead and arranged with ventilators through the car roof to conduct away the gases and fumes given off when the batteries are on charge. In one corner is installed a 15-k.w. turbo-generator set, as




**Plan of Train Lighting Instruction Car on the Pennsylvania Railroad.**

formerly used on all Pennsylvania limited trains. In this case the usual switching devices are replaced by two single-pole automatic circuit breakers, giving both overload and underload protection to the machine. The field rheostat and meters are mounted on the side of the car. Connections are such that the turbo-generator can be used for driving the motor, charging the batteries, and lighting the car, though, under ordinary conditions, the motor will be driven from the yard power lines. The axle generators are mounted on rocker shafts and are equipped with springs for regulating the belt tension as is done in actual service. Immediately back of each machine is an angle iron framework on which the corresponding regulating apparatus is mounted, the equipment in each case being identical with that installed on passenger cars. Each generator is connected through suitable switching devices to the lamp load and batteries, enabling the operator to demonstrate the apparatus



Turbine and Generator at One End of the Car.

under all conditions of load. The lamps used for this are banked in porcelain receptacles on the ceiling of the car. The driving motor is of the interpole type, and is mounted on an iron framework equipped with rollers, which enable the operator to move the motor equipment along an I beam track for belting up to any one of the six generators. The control panel for this machine is secured to the movable framework and moves with the motor.

The operator's office contains a folding couch, upper berth, clothes closet and toilet, the finish throughout being white enamel. With the instruction car in operation it is intended that all employees, in both the mechanical and operating departments whose duties have to do with the car lighting shall be instructed in the care and operation of the various equipments, with the two-fold object of educating those interested and securing uniformity in their work.

## REPAIR TRACK NOTES

BY A REPAIRMAN

In spite of all that has been said during the past two or three years regarding the increasing expenditures for the maintenance of freight cars, a great many railway men do not seem able to see beyond the question of first cost. Of course, it must be admitted that a few dollars per car increase in the first cost makes a very considerable total when several thousand cars are being ordered, but if the best of everything is not used the saving made in the first cost may be much more than offset in maintenance charges in a comparatively short time. If a device of inferior design or construction were to fail once and then be replaced, conditions would not be nearly so bad, but this is almost never the case. If, for example, a door becomes disabled when on a foreign line, the weak points of the door fixtures are not brought out and remedied in making the repairs. The door is replaced in kind and another failure may take place at any moment. It is this perpetuating of devices that are not capable of giving good service that is one of the greatest causes of car maintenance expense.

* * * * * *

Where is the logic in placing a steel roof at the top of a wooden superstructure? If the roof stays on the car at all during the switching that is common in all modern yards, it will very soon start leaking; at least, that has been my experience. I am not by this condemning the steel roof by any means, but I do not believe that a roof of this type has yet been perfected nor that they have any place on cars with wooden superstructures.

* * * * * *

The arch bar truck has given good service on American railways, but it should have no place under modern freight equipment. Even provided that it is possible to keep nuts on the bolts, an arch bar is likely to crack and fail on the road at any time, tearing up the track and causing a wreck which blocks traffic. This type of truck has had its day, and should be kept out of modern freight service.

## ARE STEEL PASSENGER TRAIN CARS NEEDED?

While steel passenger train cars may be desirable from many points of view, there is a considerable question in the minds of many as to the advisability of unnecessarily expending money for them when it might far better be spent in other ways which will go to the very root of things and eliminate the causes which are responsible for the accidents. After all, the number of lives that may be saved by the use of such equipment is only an extremely small percentage of the lives lost annually on railroads. For instance, for the year ended June 30, 1912, 318 passengers were killed and 16,386 injured, while 3,235 employees were killed and 50,079 injured, and 6,632 other persons were killed and 10,710 injured. Only 3.1 per cent. of those killed and 21.2 per cent. of those injured were passengers, and this is the class to which the introduction of steel cars will be of greatest benefit. Furthermore, less than one-half of the passengers killed were in collisions or derailments. The others were killed or injured largely because of want of care on the part of the victims themselves.

If laws are to be enacted forcing the roads to equip with steel passenger cars, it would hardly seem necessary, or even advisable in many cases, to require such cars except on roads or divisions where the traffic is heavy and is operated at high speed. Where trains are operated at slow speed, or are few in number and small, as they are on many roads or on some divisions and branches of large systems, it is useless to require all-steel cars. The money could be better spent in providing safeguards to prevent accidents.—*Railway Age Gazette.*

# STEEL UNDERFRAME BOX CARS*

## Tabular Comparison of Several Underframes; Reasons for More Effort Toward Standardization.

BY GEORGE W. RINK,
Mechanical Engineer, Central Railroad of New Jersey, Jersey City, N. J.

It is surprising, in view of the interchange of steel underframe box cars among the railroads, that more has not been accomplished during the past five years toward standardization in design of the various component parts, particularly those which affect the cost of maintenance and require constant repairs due to wear and unavoidable accidents.

During the year 1912, there were built 107,887 box cars of various capacities and dimensions, all varying vastly in detail design of important parts which require frequent renewal, thus making it necessary for all railway storehouses to carry an unnecessarily large stock of repair parts running into very large sums of money. Standards have been adopted by the Master Car Builders' Association which have in large measure reduced the amount of stock necessary to carry. I believe the time has arrived to introduce additional standards affecting the maintenance of box cars which can also be applied to all types of freight cars used in interstate business.

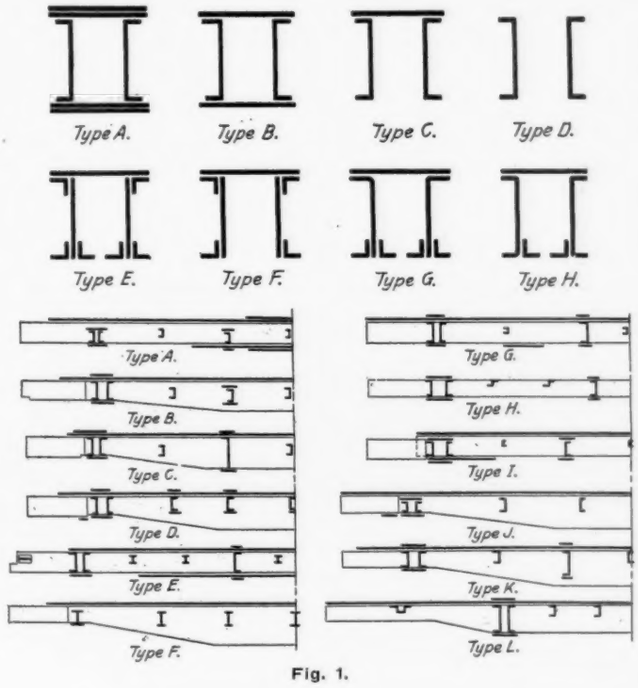



Fig. 1.

It is reasonable to assume that every railroad manager desires to purchase cars built in a substantial manner. In the absence of standard construction and because of competition, the car builders, when asked to furnish estimates and designs, will sometimes figure on material too light for the service. This, however, is not the fault of the car builder, since, from my own experience, I know that they will gladly add the material where needed, provided they are paid a fair price for the car.

From my observation of steel underframe box cars, I must conclude that engineers did not understand the importance of low fiber stresses in the early designs of steel underframes; sufficient attention was not given to the tremendous impact blow which the center sills and car framing have to resist, with the result that large sums of money are now being spent by railroads in making repairs to these cars by reinforcing broken center and draft sills, applying larger capacity draw gears and attachments, and heavier sills. It is not alone the larger locomotives we are using today which has called for a more thorough investigation of the subject of car design and construction, but also the severe shocks which cars are receiving in classification yards. Also the superstructure of box cars should receive just as much attention as the underframe, for how can the roofs be kept in alinement on cars having wood side posts and braces and loose tie rods? The roof is bound to work loose, resulting in leaks which prevent the use of the car for certain commodities.

The application of steel center sills to old cars will no doubt prolong their life. This is now being done by almost every railroad on cars built just prior to the advent of all-steel underframe box cars, but care should be taken to see that sufficient metal is provided to withstand the present service requirements, keeping in view a margin of safety for the future, as no doubt it would be desirable to maintain in service for at least ten years cars to which these steel center sills are applied.

Railway officials in charge of car repairs have seen the results of poor designing and light construction of the earlier steel underframe cars, and during the past three years have materially assisted in the development of the art by insisting upon the production of a stronger car, one that will hold together in all kinds of service with the minimum cost of repairs.

The accompanying tables, numbered 1 to 4, have been compiled to show interesting information on the subject of center sill constructions for 14 different cars, the types of underframes used in which are shown in outline in Fig. 1. The heavy lines in the drawings indicate the cover plates used which appear to be a general practice among designers. This is considered by many to be a very desirable feature and besides adding to the rigidity of the structure as a whole, increases the net area of the section and therefore reduces the fiber stress to within reasonable figures.

The strains which an underframe has to withstand vary, and depend a great deal on the design and arrangement of the body bolsters, side sills and body framing. With substantial side sills and body bolsters, compressive strains can be transmitted by the latter and thus part of the compressive load can be taken care of by the side sills. However, there is a limit to the load the side sills can take care of which is based on the ratio of length to the least radius of gyration, the length being considered as the maximum distance between adjacent floor beams. In the case of cars with wood body side framing it would appear desirable to provide sufficient area at the smallest section of the center sills to take care of end strains, allowing the side sill to carry only its proportion of the vertical loads due to lading, weight of superstructure and an allowance for vibration.

In the case of box cars with steel side frames there is no question about the ability of the frame structure to carry considerably greater loads, both vertically and due to end shock, on account of the diagonal braces assisting in transmitting the strain throughout the side. For this reason some designers do not consider it necessary to use continuous cover plates on the center sills, but use rolled steel sections for these sills, having

*An extract from a paper read before the American Society of Mechanical Engineers at the annual meeting, December 3, 1913.

TABLE 1.—DATA AT CENTER FOR CARS WITH WOOD SIDE FRAMES.

| Road. | Sill Type. | Section Type. | Depth over Flanges, In. | Web Plate, In. | Outside Top Angle, In. | Bottom Angle, In. Outside. | Bottom Angle, In. Inside. | Cover Plate, In. Top. | Cover Plate, In. Bottom. | Minimum Area, Sq. In. | Neutral Axes. $X_c$ | Neutral Axes. $X_t$ | Section Moduli. $S_c$ | Section Moduli. $S_t$ | Max. Stress due to Vertical Loads, Lbs. per Sq. In. | Compression due to End Shock, Lbs. per Sq. In. | Compression due to Eccentricity, Lbs. per Sq. In. | Maximum Combined Compression, Lbs. per Sq. In. | Center Line of Draw Gear above or below Neutral Axis, In. | $\frac{1}{A}+\frac{e}{S}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. L. & W... | A | A | 12 | .. | ..... | ..... | ..... | 2–¼x19 | 2–¼x19 | 32.12 | 6.21 | 6.79 | 154.16 | 141. | 9851*c* 10770*t* | 9338 | 9402 | 12787 | 3.29 below | 0.054 |
| C. R. R..... | A | A | 15 | .. | ..... | ..... | ..... | 1–⅝x20½ | 1–⅝x20½ | 36.23 | 7.67 | 8.20 | 208.24 | 196.0 | 7421*c* 7885*t* | 8279 | 701 | 16401 | .487 above | 0.029 |
| N. Y. O. & W. | B | G | 24 | ¼ | 3⅞ fl. | 3½x3x⅞ | 3½x3x⅞ | 1–¼x20½ ¼x21¼ | 1–¼x20½ ..... | 27.67 | 12.74 | 11.51 | 212.57 | 235.28 | 8462*c* 7645*t* | 10842 | 2455 | 21759 | 1.74 above | 0.0442 |
| P. & R..... | C | E | 26 | ⅜ | 4x4x½ | 4x4x½ | 4x4x½ | ¼x22½ | ..... | 45.01 | 13.06 | 13.19 | 377.69 | 373.97 | 5514*c* 5569*t* | 6664 | 5012 | 17190 | 6.31 above | 0.038 |
| B. & A..... | D | E | 22 | ¼ | 3x3x⅜ | 3x3x⅜ | 3x3x⅜ | ¼x20¼ | ..... | 26.84 | 10.18 | 12.07 | 213.77 | 180.30 | 8927*c* 10584*t* | 11177 | 3410 | 23514 | 2.43 above | 0.0485 |
| C. & N. W.... | E | B | 15 | .. | ..... | ..... | ..... | ⅜x20 | ⅜x20 | 33.12 | 7.51 | 8.24 | 173.73 | 158.34 | 12872*c* 14123*t* | 9056 | 6321 | 15607 | 4.49 below | 0.058 |
| Un. Pac. ..... | F | E | 30½ | ¼ | 3x3x⅛ | 3x3x⅜ | 3x3x⅝ | ¼x20½ | ..... | 32.09 | 15.26 | 15.49 | 317.92 | 313.2 | 8566*c* 8694*t* | 9346 | 5671 | 23583 | 6.01 above | 0.049 |

TABLE 2.—DATA AT CENTER FOR CARS WITH STEEL SIDE FRAMES.

| Road. | Sill Type. | Section Type. | Depth over Flanges, In. | Web Plate, In. | Outside Top Angle, In. | Bottom Angle, In. Outside. | Bottom Angle, In. Inside. | Cover Plate, In. Top. | Cover Plate, In. Bottom. | Minimum Area, Sq. In. | Neutral Axes $X_c$ | Neutral Axes $X_t$ | Section Moduli. $S_c$ | Section Moduli. $S_t$ | Max. Stress due to Vertical Loads, Lbs. per Sq. In. | Compression due to End Shock, Lbs. per Sq. In. | Compression due to Eccentricity, Lbs. per Sq. In. | Maximum Combined Compression, Lbs. per Sq. In. | Center Line of Draw Gear above or below Neutral Axis, In. | $\frac{1}{A}+\frac{e}{S}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C. & O..... | G | C | 15 | .. | ..... | ..... | ..... | ⅝x19¾ | ..... | 25.96 | 6. | 9.31 | 150.03 | 96.69 | 10972*c* 17025*t* | 7704 | 7345 | 11331 | 5.56 below | .095 |
| Erie ..... | H | D | 15 | .. | ..... | ..... | ..... | ..... | ..... | 18.73 | 7.092 | 7.908 | 80.0 | 71.72 | 20311*c* 22655*t* | 10678 | 10275 | 20714 | 4.158 below | 0.1112 |
| Can. Pac. ..... | H | D | 15 | .. | ..... | ..... | ..... | ..... | ..... | 18.73 | 7.092 | 7.902 | 80.0 | 71.72 | 30311*c* 22653*t* | 10678 | 13270 | 17719 | 5.408 below | 0.1287 |
| Wabash ..... | I | C | 15 | .. | ..... | ..... | ..... | ⅞x20 | ..... | 26.05 | 5.98 | 9.33 | 151.04 | 96.8 | 10887*c* 16987*t* | 7677 | 6806 | 11758 | 5.14 below | 0.091 |
| Frisco ..... | J | E | 26 | ¼ | 3x3x¼ | 3x3x⅜ | 3x3x⅞ | ¼x20 | ..... | 26.89 | 12.38 | 13.87 | 235.53 | 210.23 | 8725*c* 9775*t* | 7437 | 747 | 16909 | .88 above | 0.04 |
| U. P. ..... | K | G | 27¾ | ¼ | 3⅞ fl. | 3½x3x⅜ | 3½x3x⅜ | ¼x23 | ..... | 28.78 | 13.94 | 14.06 | 261.67 | 259.43 | 9053*t* 9131*c* | 6949 | 3829 | 19831 | 5.0 above | 0.053 |
| P. R. R..... | L | H | 20 | ⅜ | 4 fl. | 4 fl. | 4x4x⅞ | ⅜x2 | ..... | 35.91 | 9.55 | 10.82 | 258.58 | 228.34 | 10606*c* 12009*t* | 5569 | 2266 | 18441 | 2.93 above | 0.039 |

TABLE 3.—DATA AT BOLSTER FOR CARS WITH WOOD SIDE FRAMES.

| Road. | Sill Type. | Section Type. | Depth over Flanges, In. | Web Plate, In. | Outside Top Angle, In. | Bottom Angle, In. Outside. | Bottom Angle, In. Inside. | Cover Plate, In. Top. | Cover Plate, In. Bottom. | Minimum Area, Sq. In. | Neutral Axes. $X_c$ | Neutral Axes. $X_t$ | Section Moduli. $S_c$ | Section Moduli. $S_t$ | Compression due to End Shock, Lbs. per Sq. In. | Compression due to Eccentricity, Lbs. per Sq. In. | Maximum Combined Compression, Lbs. per Sq. In. | Center Line of Draw Gear above or below Neutral Axis, In. | $\frac{1}{A}+\frac{e}{S}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. L. & W.... | A | B | 12 | .. | ..... | ..... | ..... | ¼x19 | ¼x19 | 24.20 | 6.25 | 6.25 | 103.11 | 103.11 | 12396 | 8728 | 21124 | 3.00 below | .07 |
| C. R. R..... | A | C | 15 | .. | ..... | ..... | ..... | ¼x20½ | ..... | 23.91 | 6.33 | 8.92 | 134.27 | 95.28 | 12547 | 2109 | 14656 | .67 below | .048 |
| N. Y. O. & W. | B | G | 15 | ¼ | 3⅞ fl. | 3½x3x⅞ | 3½x3x⅞ | ¼x21¼ | ..... | 25.00 | 8.42 | 6.83 | 119.84 | 147.76 | 12000 | 5238 | 17238 | 2.58 below | .057 |
| P. & R..... | C | E | 11¼ | ⅜ | 4x4x½ | 4x4x½ | 4x4x½ | ¼x22½ | ..... | 36.18 | 5.91 | 5.59 | 124.68 | 131.82 | 8291 | 1911 | 10202 | .84 below | .033 |
| B. & A..... | D | E | 12⅞ | ¼ | 3x3x⅜ | 3x3x⅜ | 3x3x⅜ | ¼x20¼ | ..... | 23.90 | 6.28 | 6.84 | 110.31 | 101.13 | 12552 | 4331 | 16883 | 1.46 below | .055 |
| C. & N. W..... | E | C | 15 | .. | ..... | ..... | ..... | ⅜x20 | ..... | 27.30 | 5.76 | 9.61 | 164.24 | 98.44 | 10989 | 18986 | 29975 | 6.23 below | .099 |
| Un. Pac. ..... | F | F | 12⅞ | ¼ | 3x3x⅞ | 3x3x⅜ | ..... | ¼x20½ | ..... | 19.08 | 5.11 | 8.01 | 97.61 | 62.33 | 15719 | 19901 | 35620 | 4.135 below | .118 |

TABLE 4.—DATA AT BOLSTER FOR CARS WITH STEEL SIDE FRAMES.

| Road. | Sill Type. | Section Type. | Depth over Flanges, In. | Web Plate, In. | Outside Top Angle, In. | Bottom Angle, In. Outside. | Bottom Angle, In. Inside. | Cover Plate, In. Top. | Cover Plate, In. Bottom. | Minimum Area, Sq. In. | Neutral Axes. $X_c$ | Neutral Axes. $X_t$ | Section Moduli. $S_c$ | Section Moduli. $S_t$ | Compression due to End Shock, Lbs. per Sq. In. | Compression due to Eccentricity, Lbs. per Sq. In. | Maximum Combined Compression, Lbs. per Sq. In. | Center Line of Draw Gear above or below Neutral Axis, In. | $\frac{1}{A}+\frac{e}{S}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C. & O..... | G | C | 15 | .. | ..... | ..... | ..... | ⅝x19¾ | ..... | 25.96 | 6. | 9.31 | 150.03 | 96.69 | 7704 | 11500 | 19204 | 5.56 below | 0.95 |
| Erie ..... | H | D | 15 | .. | ..... | ..... | ..... | ..... | ..... | 19.8 | 7.5 | 7.5 | 83.4 | 83.4 | 10101 | 9100 | 19201 | 3.75 below | 0.095 |
| Can. Pac. .... | H | D | 15 | .. | ..... | ..... | ..... | ..... | ..... | 19.8 | 7.5 | 17.5 | 83.4 | 83.4 | 10101 | 11990 | 22091 | 5.0 below | 0.110 |
| Wabash ..... | I | C | 15 | .. | ..... | ..... | ..... | ⅞x20 | ..... | 26.05 | 5.98 | 9.33 | 151.04 | 96.8 | 7677 | 10620 | 18297 | 5.14 below | 0.091 |
| Frisco ..... | J | E | 13⅞ | ¼ | 3x3x¼ | 3x3x⅜ | 3x3x⅞ | ¼x20 | ..... | 22.34 | 6.93 | 7.19 | 108.01 | 104.1 | 8953 | 8760 | 17713 | 4.56 below | 0.088 |
| Un. Pac. ..... | K | G | 13 | ¼ | 3⅞ fl. | 3½x3x⅜ | 3½x3x⅜ | ¼x23 | ..... | 23.03 | 6.86 | 6.39 | 103.54 | 111.16 | 8684 | 4174 | 12858 | 2.32 below | 0.063 |
| P. R. R..... | L | H | 11 | ⅜ | 4 fl. | 4 fl. | 4x4x⅝ | ⅜x24 | ..... | 30.68 | 5.38 | 5.99 | 125.8 | 113.0 | 6513 | 2194 | 8707 | 1.24 below | 0.043 |

a much smaller net area than what is considered good practice by others.

In order to properly analyze the stresses in underframes a standard method of comparison should be made. Cars do not fail as a rule because of the weight of lading, but principally because of strains transmitted through the coupler. The magnitude of the end shocks that underframes have to withstand was investigated in tests conducted prior to 1902, on the Lake Shore & Michigan Southern with a dynamometer car having a capacity of 300,000 lbs. It was found that the tensile and buffing strains, with an engine having a tractive effort of 36,000 lbs., were from 50,000 to 70,000 lbs., and 80,000 to 150,000 lbs. respectively, depending upon the skill of the engineer in manipulating the engine, the train remaining intact. In coupling an engine to its train, buffing strains from 65,000 to 142,000 lbs. were obtained. Thirty cars moving at about 6½ miles an hour, and coupling to ten loaded cars with brakes set, gave a shock of 376,492 lbs. It would appear from the above results that provisions should be made in designing a steel underframe box car to take care of an impact blow of 350,000 lbs. transmitted throughout all sills.

It would therefore seem advisable to assume an end strain of 200,000 lbs. on the center sills of box cars with steel side frames and 300,000 lbs. for box cars with wood side frames for the reasons previously mentioned. If the center line of the coupler was directly on a line with the neutral axis of the section to be analyzed, the stress per square inch on the center sills due to end shocks would be equal to the buffing force $B$ divided by the area $A$ of the section. Referring to the tables, the area of the sills is given both at the center line of the car and near the bolster. The eccentricity $e$, or the distance from the center line of the draw gear to the neutral axis is also given for these sections. The stress at the bolster due to eccentricity equals $\frac{Be}{S_t}$ when the center line of the draw gear is below the neutral axis, and $\frac{Be}{S_c}$ when the center line is above the neutral axis. The combined stress at the bolster equals $\frac{B}{A} + \frac{Be}{S_t}$ or $\frac{B}{A} + \frac{Be}{S_c}$, depending upon the location of the center line of the draw gear. At the center line of the car, compression stress due to the lading equals $\frac{M}{S_c}$. Stress due to eccentricity equals $\frac{Be}{S_c}$. Stress due to end shock equals $\frac{B}{A}$. When the center line of the draw gear at the center of the car is below the neutral axis, the combined stress equals $\frac{M}{S_c} + \frac{B}{A} \frac{Be}{S_c}$, and if the center line is above, the combined stress equals $\frac{M}{S_c} + \frac{B}{A} + \frac{Be}{S_c}$. The ratio of stress to the end strain is obtained by the formula $\frac{1}{A} + \frac{e}{S}$, in which $S$ represents the section modulus, $S_t$ to be used if the center line of the draw gear is below and $S_c$ if above, the neutral axis. The Car Construction Committee of the Master Car Builders' Association recommends that the above ratio on new cars should not exceed 0.06. They also recommend a minimum center sill area of 24 sq. in.

Tables 1 and 2 give the maximum stress on center sills due to vertical loading, which was obtained by assuming a uniform load distributed throughout the sill. Calculations are based on the weight of car body, $A$, the lading, $B$, and the oscillation $C$. The car body weight $A$, carried on center sills was taken at 20,000 lbs., except for the Philadelphia & Reading box car, in which the weight used was 24,000 lbs. (assumed as two-thirds of the total weight of the car body and the underframe). The lading $B$ for 60,000 lbs. capacity cars was assumed as 66,000 lbs., for 80,000 lbs. capacity cars was assumed as 88,000 lbs., and for 100,000 lbs. capacity cars was assumed as 110,000 lbs. The oscillation $C$ was taken at 20 per cent. of the sum of the lading and the weight of the car body.

The calculations for center sill load for box cars with wood

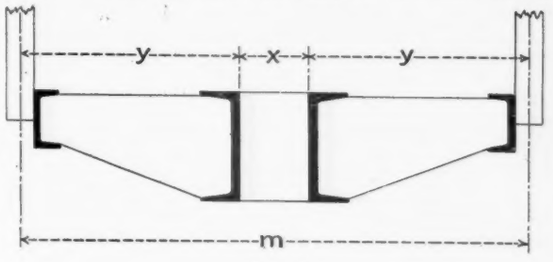



Fig. 2.

side frames were made as follows: Load per square inch of floor space

$$w = \frac{A + B + C}{lm}$$

Total uniform load on center sills,

$$W = wl\ (x + y)$$

where (see Fig. 2),

$l$ = length over centers of end posts, in inches,
$m$ = distance over centers of side posts, in inches,
$x$ = spacing of center sills,
$y$ = distance from back of center sill to center of side post, in inches.

The calculations for center sill load for box cars with steel

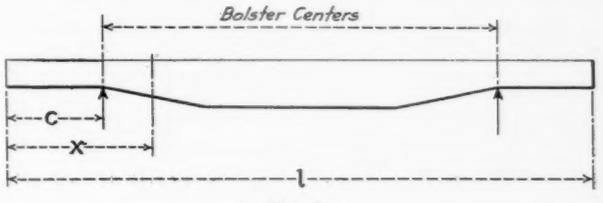



Fig. 3.

side frames were made as follows: (See Fig. 3.) Load per square inch of floor space

$$w_1 = \frac{\frac{A}{3} + B + C}{lm}$$

Total uniform load on center sills

$$W = w_1 l\ (x + y)$$

Bending moment of center sills

$$M = \frac{W}{2}\ (\frac{l}{4} - c)$$

$M$ = maximum bending moment at center of car
$c$ = distance from center line of bolster to center of end post, in inches
$\frac{M}{S_c}$ = compression per square inch
$\frac{M}{S_t}$ = tension per square inch

Bending moment at any point $x$ =

$$Mx = \frac{W}{2}\ (x - c) - \frac{Px^2}{2}$$

where

$x$ = distance in inches from center of end post to any section between bolster and center of car
$P$ = load per lineal inch of sill.

In making the calculations for the Pennsylvania Railroad box car, it was assumed that the cross bearers transmitted to the center sills a certain proportion of the weight of the car body, thus producing an additional bending moment in the center sills.

TABLE 5.—DATA FOR AREAS AND STRESSES IN CENTER SILLS.

AREA OF CENTER SILLS.

| | At Center. | | | At Bolster. | | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Aver. | Min. | Max. | Aver. |
| 36 ft. cars, wood frame... | 26.84 | 45.01 | 33.37 | 23.09 | 36.18 | 26.64 |
| 36 ft. cars, steel frame... | 18.73 | 26.05 | 22.19 | 19.80 | 26.05 | 22.72 |
| 40 ft. cars, wood frame... | 32.09 | 33.125 | 32.60 | 19.08 | 27.30 | 23.19 |
| 40 ft. cars, steel frame... | 26.89 | 35.91 | 30.52 | 22.34 | 30.68 | 25.35 |

MAXIMUM COMBINED STRESS.

| | At Center. | | | At Bolster. | | |
|---|---|---|---|---|---|---|
| | Min. | Max. | Aver. | Min. | Max. | Aver. |
| 36 ft. cars, wood frame.. | 12505 | 23514 | 18274 | 10202 | 21124 | 16020 |
| 36 ft. cars, steel frame... | 10539 | 20714 | 15182 | 18297 | 23069 | 20409 |
| 40 ft. cars, wood frame... | 15607 | 23583 | 19595 | 29975 | 35620 | 32798 |
| 40 ft. cars, steel frame... | 16909 | 19831 | 18393 | 8767 | 17713 | 13093 |

From Tables 1 to 4 are obtained the data in Table 5. For the 36 ft. cars with wood body framing, it would appear that the averages shown for the area and stress both at the bolster and the center of the car approach figures which are safe for general practice. For the 36 ft. cars with steel body framing, the average stress per square inch behind the bolster is too high for safe practice and should be reduced by increasing the area. The low combined stress at the center of the car is due to the center line of the coupler being located about 5 in. below the neutral axis, which reduces the compression due to direct end shock. At the center of the car the stress due to lading alone is also too high for safe operation. For the 40 ft. cars with wood body framing, the average stress per square inch is entirely too high and should be reduced by increasing the area of the section and cutting down the eccentric load due to end shock; this also applies to the section at the center of the car. In the 40 ft. cars with steel body framing, the maximum combined stress at the center of the car is a trifle high.

In all of these cases it is well to note that the relation of the center line of the coupler to the neutral axis has an important bearing on the strength of the sills. At the center of a car with fish-belly type sills the center line of the coupler is usually above the neutral axis, which adds to the total combined compression; whereas, with structural steel sills, the coupler center line being below the neutral axis, will counteract somewhat the compression due to impact. This leads me to believe that nothing is gained by making the depth of fish-belly sills at the center any greater than is required to take care of the vertical loads. It will also appear that a fish-belly type sill is necessary for all types of cars mentioned of 80,000 and 100,000 lbs. capacity, except 36 ft. steel side frame cars, which will render good service when using a center sill construction of plates and channels. For body bolsters, it is general practice to use two pressed steel channels spaced at various distances apart with cover plates top and bottom. The best designs have a spacing of 6 in. to 8 in. between webs. For crossbearers, a variety of designs exist, the later types consisting of heavy I-beams passing directly through the center sill web plate and extending the width of the car between side sills. This plan is also followed out on the intermediate floor beams and makes a neat and substantial arrangement. The general practice is to use a pressed steel channel with top and bottom cover plate.

For draft sills, the practice is, where structural steel channels are used for center sills, to extend them to the end sill to serve as draft sills. It has been customary when fish-belly type center sills are used, to provide pressed steel Z-shape draft sills and splice them to the center sill web plates projecting through the bolster. There is a tendency on the part of designers today to do away with the splice by extending the web plates of center sills and providing outside angles to form the draft sill using a continuous cover plate. Where pressed steel center sills and cover plates are used, the practice has been followed of extending this construction to the end sill, bringing the cover plate too near the end of the sill. This construction requires the use of web plates about 5/16 in. thick, so as to provide sufficient bearing area for draft lug rivets. I believe that when draft sills have sufficient net area behind the bolster stop, that considerations of economical construction would warrant dispensing with the splice, as in view of the additional cost of a splice on 1,000 cars, the expense of its application is not warranted when considering the number of sill failures likely to occur due to its omission.

As to draft gears, data regarding the type used have not been tabulated. It is sufficient to say that of the cars enumerated, six were equipped with spring draft gears and nine with friction gears. The impact blow resulting from cars coming together is practically absorbed by the draft gear. Friction gears are more efficient in this respect, absorbing a much greater percentage of total energy than spring gears. Owing to the large variety of gears in service, necessitating numerous designs of draft lugs, key attachments, etc., it would appear that, if a standard arrangement of draft gear and all appliances connected therewith were adopted by all railroads, it would result in great economy of maintenance. This should include striking plates and carry irons which on a large number of cars are not of sufficient strength, due to the arrangement of the end sills.

It is surprising that more has not been done in the way of standard construction of box cars. The large expenses which railroads are now compelled to face, due to repairs of freight cars could be partially reduced if standard designs were in use throughout the country. Repairs would be facilitated, due to the use of standard materials throughout for various types of cars, fewer cars would be held up at car repair shops awaiting material from foreign roads, and interchange of cars would not be a hardship to any railroad, as all cars would be of equal strength. Also drawing room expenses would be reduced both for the railroad and car builder, and repair parts could be produced by cheaper methods than those followed at present, due to the elimination of a variety of designs and shapes, principally castings and pressed steel parts.

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THE COST OF ELECTRIFICATION.—The cost of everything electric is enormous. The cost of the electric locomotive is at least double that of the steam locomotive, which they are supposed to replace, and before electric locomotives can be operated it is necessary to incur a large additional outlay for power houses, transmission systems, track preparation and all of the other apparatus and material which is necessary to complete an electric system. One estimate which has been brought to my attention provides an investment of about $200,000 for each steam locomotive displaced, or about ten times the cost of each of the latter. As there are about 70,000 locomotives in the United States, representing an investment of about one billion four hundred million dollars, I am sure you will agree with me that some exceptionally favorable return must be apparent before they will all be discarded; especially so when their replacement involves an expenditure of many times their present value. It is true that the demand is rarely made that an entire cross country line be operated by electric power, but that such operations be confined to the larger cities. Such an installation, however, except under particularly favorable conditions, involves not only a proportionately heavier investment for the electric plant, but requires the establishment of two locomotive terminals, one each side of the city, and an additional stop at each of the termini for an exchange of the steam for an electric locomotive or vice versa. Even if the railways could stand the burden of the cost, it is doubtful if the traveling public would tolerate frequent delays of this kind.—*D. F. Crawford before the International Society for the Prevention of Smoke.*

# SHOP PRACTICE

## MISCELLANEOUS SHOP KINKS

BY JOHN TODD,
Machine Shop Foreman, Erie Railroad, Galion, Ohio.

DRIVING WHEEL STAND.

The horse or stand shown in Fig. 1 is used for holding mounted driving wheels while the tires are being put on or removed. It is made of heavy material to withstand rough usage and the weight of heavy drivers. The legs are 3½ in. x 1 in., the top bar 6 in. x 1¼ in., and the braces 3½ in. x ½ in.

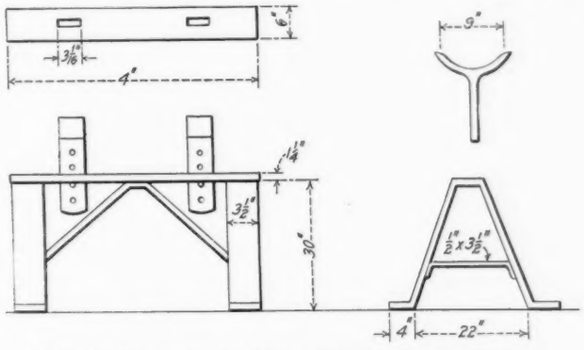



Fig. 1—Stand for Holding Mounted Driving Wheels.

The top bar is slotted to receive the axle supports, which are rounded to the shape of the axle and keep it from rolling off. They are held by pins which pass through one of the four holes, and in this way provide for the different diameters of drivers.

TESTING MACHINE FOR BOYER SPEED RECORDERS.

An outline of a machine that is used to calibrate and test Boyer speed recorders is shown in Fig. 2. It was originated by the tool room foreman at Galion, being constructed with a friction disc to give the varying speeds. The disc *A* is held in a wrought iron frame and is driven by an 8-in. pulley *B*. A 5-in. friction wheel *C*, which is made up of a leather disc between two plates,

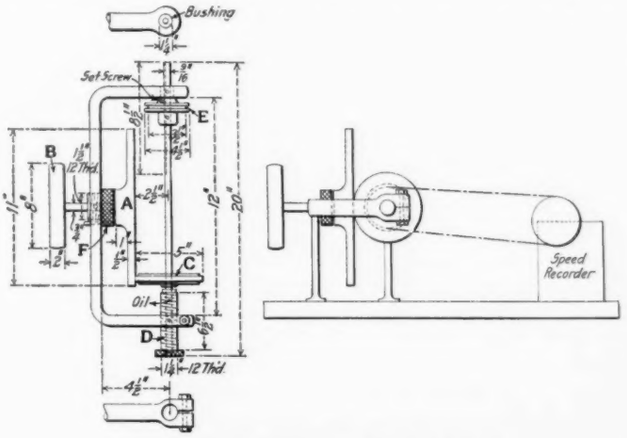



Fig. 2—Speed Recorder Testing Machine.

is rigidly fastened to the shaft that rotates in the arms of the frame. This shaft is free to slide in its bearings, the lower end of the shaft, as shown in the illustration, being held in the screw bearing *D* by two collars. This bearing is threaded in the frame and by screwing it in or out the friction wheel is moved over the disc, thus regulating the speed of pulley *E*, which drives the speed recorder. When the correct speed has been attained this bearing is clamped, as indicated by the split end on the frame, to prevent the shaft from working in or out. The pulley *E* is free to slide on the shaft and is driven by a set screw through its hub, which has a sliding fit in the keyway in the shaft. It is held in position by two collars, one formed by the machine itself and the other by an arm fastened to the base. The friction pulley is held in the screw bearing *F*, which regulates the bearing pressure between the disc and the friction pulley *C*. This bearing is kept from rotating by a pin which extends through it and the frame. The machine is driven in this specific case from an emery wheel by a 1¼-in. belt, with which a speed of from one to 100 m. p. h. may be obtained. The machine runs smoothly and gives very good results, showing no vibration of the pen on the recording chart.

DEVICE FOR PRESSING IN HOSE CONNECTIONS.

The device shown in Fig. 3 is used for applying the coupling connections to blower hose, washout hose, pneumatic tool hose, etc. It is made up of two 5-in. blocks drilled out a little smaller

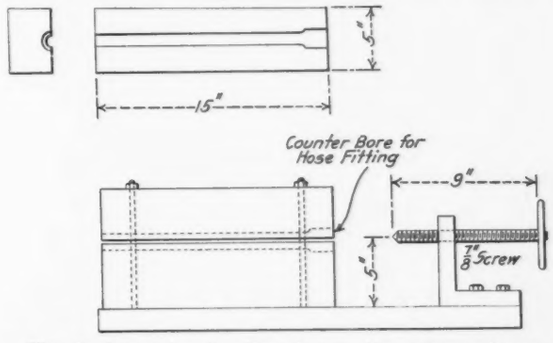



Fig. 3—Apparatus for Pressing in Hose Connections.

than the hose so as to firmly grip it. One end is counterbored to allow for the expansion of the hose when the connection is forced in by the ⅞-in. screw operating in the angle support. This device is used on hose from ½ in. to 2½ in. in diameter with good results. The two blocks are clamped together by a ⅝-in stud located at each corner, and there is very little chance of the hose slipping.

JIG FOR SPLITTING ARCH TUBE PROSSERS.

The jig shown in Fig. 4 is used for splitting arch tube prossers. It consists of the mandrel *A* and the two blocks *B* and *C*,

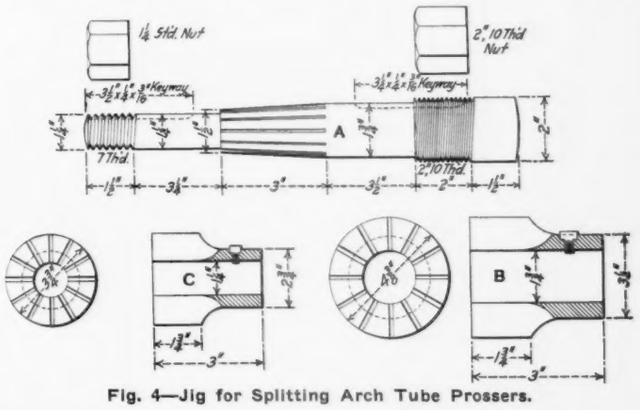



Fig. 4—Jig for Splitting Arch Tube Prossers.

which are split as shown and act as guides to the saw used for cutting the prosser. The mandrel is made with a tapered sec-

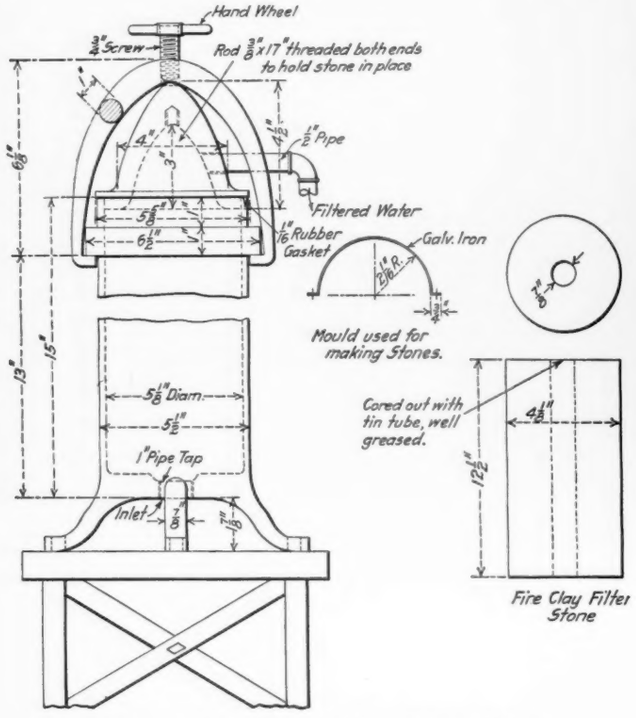
tion to correspond to the taper in the prosser, and the latter is forced on lightly to insure an even bearing. The guide block *B* is placed on the large end, and *C* on the small end of the mandrel. Both are held by a set screw key which slides in the keyways shown so that the slots will be in line with each other. After the prosser has been placed on the mandrel, these split guides are forced against the end of it by their corresponding nuts, gripping the prosser firmly between them. The work is done on a milling machine with a 3/32 in. saw, and the same jig can be used to make 2-in. prossers as well.

## FILTER FOR SHOP DRINKING WATER

BY PAUL R. DUFFEY

A very simple and efficient filter, having a capacity of about 30 gals. per hour under ordinary conditions, is shown in the illustration. It consists of a cast iron body and head, a wrought iron yoke for holding the head in place, a screw for the yoke, a rubber gasket, a rod for holding the filter stone and a suitable composition stone.

A very good filter stone may be purchased, or one which gives satisfactory results may be made of a good grade of fire clay. In making a stone, a set of molds of the size required are set on a smooth ramming board. A sufficient amount of fire clay and water is then mixed until the mass has the consistency of




Filter and Filter Stone for Shop Drinking Water.

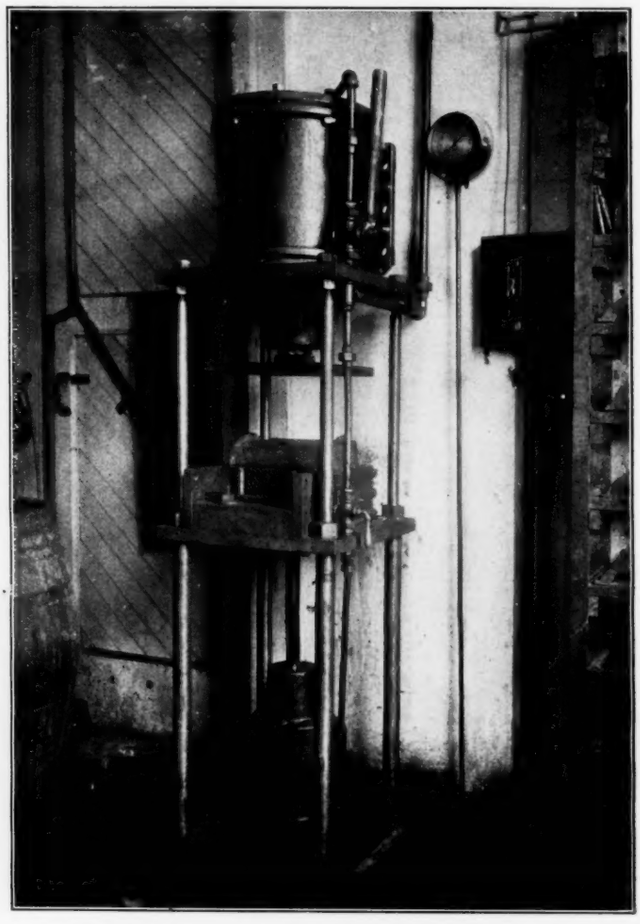
dough, when the molds are filled and the material is rammed until no open spaces are left. The stone should then be placed in a warm place for several days till it hardens sufficiently to permit the removal of the forms, when it is placed in a suitable kiln and baked until the desired degree of hardness is reached.

When the filter is in use, water enters at the bottom inlet pipe and passes upward between the inside wall of the filter body and the outside of the stone. The water before passing out at the top must work its way through the stone, thus leaving the sediment on the outside face of the latter, which should be cleaned frequently.

## PREPARING HARD GREASE FOR JOURNAL BOX CELLARS

BY H. E. BLACKBURN,
Apprentice Instructor, Erie Railroad, Dunmore, Pa.

In preparing the grease cakes for driving and truck box cellars with the device illustrated, a wooden former of the correct radius is placed in the cast iron box and supports the perforated plate. The grease is then placed above the perforated



Device for Filling Hard Grease Cellars.

plate and rammed down by the square plate on the piston rod of the driver brake cylinder. When the cake is formed to the required size it is ejected from the box by means of a ram on the piston rod of the 6 in. brake cylinder shown at the bottom of the apparatus.

CONCRETE REFLECTORS.—Concrete reflectors are to be used in the lock chambers of the Pedro Miguel Lock of the Panama Canal in preference to the enamelled steel reflectors, the choice being determined by the lower price of the former, by the more suitable light distribution effected, and by the restricted head room which prevents the use of projecting fittings.—*The Engineer.*

OCTOBER ANTHRACITE SHIPMENTS.—The total shipments of anthracite coal from Pennsylvania in October were 6,665,321 tons, as against 6,338,194 tons in October, 1912, a decrease of 327,127 tons. The amount of coal on hand at tidewater shipping ports increased 25,418 tons, from 577,805 tons on September 30, to 603,223 tons on October 31. The total shipments of anthracite coal in the first ten months of 1913 were 57,620,079 tons.

# GRINDING WHEELS AND THEIR USE

## First Prize Article in the Competition on Grinding. Instructions for Selection, Care and Use.

BY WALTER R. HEDEMAN

In a large railroad shop it is most advisable to make a careful study of the material, size and shape of grinding wheels and to ascertain the best combination for each class of work. The results can be put in the form of a set of instructions and reference tables for the guidance of all concerned.

In one of the largest railroad locomotive and car repair shops of the country, a study of this kind was made with the results shown in the accompanying table. This table permits the proper wheel for any class of work to be readily obtained and, in connection with the instruction pamphlet, has resulted in a surprising improvement in the quality of work performed on these machines and a very great saving in time.

It will be seen in the table that grinding wheels are used in practically all the different shops. They have been installed in both the iron and brass foundries where they are used to grind castings on which no finish has been allowed; also in the blacksmith shop, where they are used to grind the flash off of machine-made forgings. In the pattern shop considerable work which was previously done by filing is now done on an emery wheel, and of course in the machine shop, piston rods, valve stems, and guides, as well as a large amount of work which was formerly done by hand filing are now finished on grinders.

The instructions prepared cover the purchase and care of all abrasive grinding wheels, and are as follows:

*Size and Grade:* Size, shape and grade of wheel is to be determined by the machine on which it is to be used and the work to be done.

The grade is to be selected in accordance with the following table and the scale shown on page 665:

| Class of work. | Grade letter. | Wet or dry grinding. |
|---|---|---|
| Brass castings (large) | G+ to H | Dry |
| Brass castings (small) | H to I | Dry |
| Car wheels | G+ to I+ | Dry |
| Cast iron | F to H | Dry |
| Drop forgings | G+ to H+ | Dry |
| Wrought iron | H+ to H | Dry |
| Steel castings | G+ to H | Dry |
| Tool steel (hardened) | I to J | Wet or dry |

*Test of Wheels Before Mounting:* All grinding wheels are to be tested before mounting by tapping lightly with a hammer; if the wheel does not ring with a clear tone, it should not be used.

*Preferred Sizes:* Wherever possible, the diameter and thickness of wheel should be in accordance with the following table (sizes marked with a star to be given special preference):

| New wheel. | | | | | Take off | |
|---|---|---|---|---|---|---|
| Diam. In. | Thickness. In. | Diam. of shaft. In. | Max. R. P. M. | Surface speed. Ft. per min. | wheel at diam. of. In. | Diam. flanges. In. |
| 8 | 1½ | ¾ | 2,865 | 6,000 | 5 | 4 |
| 12* | 2 | 1 | 1,910 | 6,000 | 8 | 6 |
| 18* | 3 | 1¾ | 1,273 | 6,000 | 12 | 9 |
| 24* | 4 | 2 | 955 | 6,000 | 16 | 12 |
| 30 | 4 | 2½ | 764 | 6,000 | 18 | 15 |
| 36* | 4 | 3 | 637 | 6,000 | 24 | 18 |

*Speed:* The maximum surface speed of grinding wheels must in no case exceed 6,000 ft. per minute.

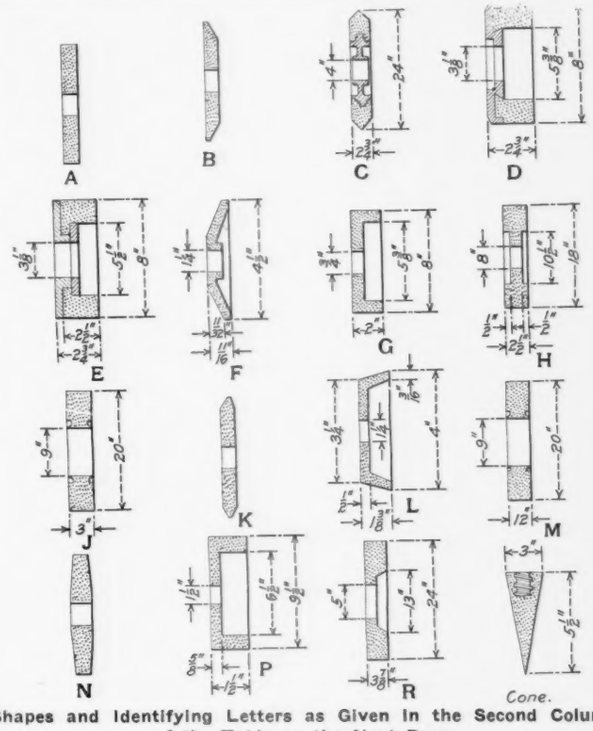
The maximum surface speed should be not less than 3,600 ft. per minute.

*Arbor Holes:* The arbor holes in all grinding wheels should be at least .005 in. larger than standard size of the spindle; in no case should a grinding wheel be forced on the spindle.

*Flanges:* The standard flanges for grinding wheels are given in one of the illustrations. The diameter of flanges is to be not less than one-half the diameter of the wheel. Flanges are to be recessed and have a true bearing on the wheel at the outer edge of flanges only. Inside flanges are to be keyed on the shaft. Grinding wheels must never be run without the proper size of flanges.

*Compressible Washers:* Compressible washers of pulp, rubber, or leather, slightly larger than the flanges, must be placed between the grinding wheel and both flanges, to distribute the pressure evenly when the flanges are tightened up.

*Tightening Flanges:* Flanges are to be tightened only enough to hold the wheels firmly. Never apply any unnecessary force. A man with a 2-ft. wrench can exert a pressure of 1½ tons on a wheel having a 1½-in. spindle. This is sufficient to break any grinding wheel.




**Shapes and Identifying Letters as Given in the Second Column of the Table on the Next Page.**

*Speed Table:* The number of revolutions per minute of the spindle, for the different diameters of grinding wheels, is to be in accordance with the following table:

| Diameter of wheel. Inches. | Minimum R. P. M. for a surface speed of 4,000 ft. | Standard R. P. M. for a surface speed of 5,000 ft. | Maximum R. P. M. for a surface speed of 6,000 ft. |
|---|---|---|---|
| 1 | 15,279 | 19,099 | 22,918 |
| 2 | 7,639 | 9,549 | 11,459 |
| 3 | 5,093 | 6,366 | 7,639 |
| 4 | 3,820 | 4,775 | 5,730 |
| 5 | 3,056 | 3,820 | 4,584 |
| 6 | 2,546 | 3,183 | 3,820 |
| 7 | 2,183 | 2,728 | 3,274 |
| 8 | 1,910 | 2,387 | 2,865 |
| 10 | 1,528 | 1,910 | 2,272 |
| 12 | 1,273 | 1,592 | 1,910 |
| 14 | 1,091 | 1,364 | 1,637 |
| 16 | 955 | 1,194 | 1,432 |
| 18 | 849 | 1,061 | 1,273 |
| 20 | 764 | 955 | 1,146 |
| 22 | 694 | 868 | 1,042 |
| 24 | 637 | 796 | 955 |
| 26 | 586 | 733 | 879 |
| 28 | 546 | 683 | 819 |
| 30 | 509 | 637 | 764 |
| 32 | 477 | 596 | 716 |
| 34 | 449 | 561 | 674 |
| 36 | 424 | 531 | 637 |
| 38 | 402 | 503 | 603 |
| 40 | 382 | 478 | 573 |

*Speed Regulation:* Countershaft and spindle pulleys are to be arranged to give 6,000 ft. surface speed for the largest grinding wheel used on any particular machine.

When a grinding wheel which has been worn down to such diameter that its surface speed falls below 3,600 ft. per minute, the speed of spindle should be increased to give the small diameter of wheel a surface speed of 6,000 ft. In place of changing the speed of the spindle to suit the diameter of grinding wheels as they wear down, it is preferable, where shop conditions permit, to remove the partly worn wheel to another machine whose spindle is such that the surface speed of 6,000 ft. may be maintained.

Operators should not be permitted to use grinding wheels until the foreman in charge has ascertained, by use of speed indicator, that the speed is correct.

*Safety Stops:* To prevent the use of large diameter grinding wheels on machines where the spindle speed is adjusted for small diameter wheels, a safety stop should be placed in some fixed point of the machine, as shown in the illustration.

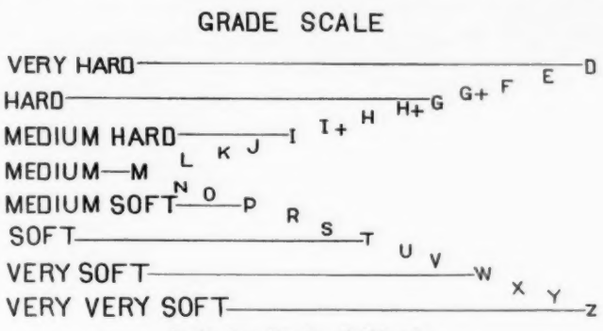
*Notices on Machines:* Each machine is to have a notice hung

SIZE, SHAPE, USE, ETC., OF GRINDING WHEELS.

| Wheel No. | Shape. (See diagrams) | Outside diam. In. | Face. In. | Bore. In. | Number of wheels in service. | Material. | Machine. | Work used on. | Shop. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | B | 8 | ½ | ⅝ | 1 | Carbondite. | Higley saw grinder. | Cold saws. | Machine. |
| 2 | A | 10 | ½ | 1 | 2 | Carbondite. | Single floor grinder. | Twist drills. | Machine. |
| 3 | A | 12 | ¾ | 5 | 1 | Carbondite. | B. & S. Universal grinder. | Cutters. | Machine. |
| 4 | D | 8 | 2¾ | 3⅛ | 3 | Emery. | Sellers twist drill grinder. | Drills. | Machine, boiler and erecting shops. |
| 5 | C | 24 | 2¾ | 4 | 1 | Emery. | Sellers No. 1 tool grinder. | Large tools. | Machine. |
| 6 | E | 8 | 2¾ | 3⅛ | 3 | Emery. | Sellers twist drill grinder. | Drills. | Machine, boiler and erecting shops. |
| 7 | A | 3 | 1/16 | 17/32 | 3 | Emery. | Sellers twist drill grinder. | Drills. | Machine, boiler and erecting shops. |
| 8 | R | 24 | 3⅞ | 5 | 1 | Carbondite. | Norton gap grinder. | Piston rods. | Machine. |
| 9 | J | 20 | 3 | 9 | 8 | Emery. | Springfield wet tool grinder. | Large tools. | Machine, boiler, axle shops and brass foundry. |
| 10 | A | 36 | 4 | 24 | 6 | Emery. | Springfield wet tool grinder. | Large tools. | Machine, erecting shops and car repairing department. |
| 11 | A | 12 | 2 | 1 | 16 | Emery. | Double floor grinder. | Tools, small castings and general use. | Machine, erecting, boiler, pattern shops, brass foundry and pass. car dept. polishing room. |
| 12 | A | 12 | ⅜ | 1 | 1 | Carbondite. | Double floor grinder. | Small tools. | Machine. |
| 13 | A | 12 | ¾ | 5 | 1 | Carbondite. | Morse Universal grinder. | Tools, pins, etc. | Machine. |
| 14 | A | 6 | ½ | ½ | 1 | Carbondite. | Morse motor attachment. | Tools, pins, etc. | Machine. |
| 15 | A | 12 | 3/32 | 1 | 1 | Elastic. | Slack cut-off saw. | Tool steel. | Machine. |
| 16 | A | 8 | ½ | 1¼ | 1 | Carbondite. | Walker tool grinder. | Surfacing tools. | Machine. |
| 17 | K | 12 | ⅜ | 1 | 1 | Carbondite. | Double floor grinder. | Beading tools. | Machine. |
| 18 | L | 4 | 1⅜ | 1¼ | 1 | Carbondite. | Walker tool grinder. | Tools. | Machine. |
| 19 | F | 4½ | 11/16 | 1¼ | 1 | Carbondite. | Walker tool grinder. | Tools. | Machine. |
| 20 | M | 20 | 12 | 9 | 1 | Emery. | Springfield guide bar grinder. | Guides. | Machine. |
| 21 | N | 20 | 12 | 3 | 1 | Emery. | Springfield guide bar grinder. | Guides. | Machine. |
| 22 | A | 4 | 6 | 1 | 1 | Emery. | Swing frame grinder. | Rods. | Machine. |
| 23 | A | 2½ | 6 | 1 | 1 | Carbondite. | Swing frame grinder. | Rods. | Machine. |
| 24 | A | 7 | 6 | 1¼ | 1 | Emery. | Swing frame grinder. | Rods. | Machine. |
| 25 | A | 4 | 5 | 1¼ | 1 | Emery. | Swing frame grinder. | Rods. | Machine. |
| 26 | A | 16 | 3 | 1 | 1 | Emery. | Swing frame grinder. | Rods, links, brass journals. | Machine. |
| 27 | A | 2⅝ | 4 | ¾ | 1 | Carbondite. | Hammett radius link grinder. | Links. | Machine. |
| 28 | A | 2 | 4 | ¾ | 1 | Carbondite. | Hammett radius link grinder. | Links. | Machine. |
| 29 | A | 1½ | 4 | ¾ | 1 | Carbondite. | Hammett radius link grinder. | Links. | Machine. |
| 30 | A | 2 | ¾ | ½ | 1 | Carbondite. | Link radius grinder. | Links. | Machine. |
| 31 | A | 1½ | ¾ | ½ | 1 | Carbondite. | Link radius grinder. | Links. | Machine. |
| 32 | A | 1 | ¾ | ½ | 1 | Carbondite. | Link radius grinder. | Links. | Machine. |
| 33 | P | 9½ | 1½ | 1½ | 2 | Emery. | Yankee twist drill grinder. | Drills. | Machine and erecting shops. |
| 34 | A | 3½ | ½ | ½ | 1 | Carbondite. | Yankee twist drill grinder. | Drills. | Machine. |
| 35 | A | 16 | 2 | 1⅜ | 2 | Emery. | Double floor grinder. | Tools, drills and general use. | Smith-shop. |
| 36 | A | 26 | 4 | 2½ | 1 | Emery. | Wet tool grinder. | Large tools. | Smith-shop. |
| 37 | A | 8 | ½ | ¾ | 1 | Carbondite. | Double floor grinder. | Bolt threading dies. | Bolt shop. |
| 38 | A | 8 | ¾ | ¾ | 1 | Carbondite. | Double floor grinder. | Bolt threading dies. | Bolt shop. |
| 39 | A | 24 | 4 | 2¼ | 1 | Carbondite. | Double floor grinder. | Castings. | Iron foundry. |
| 40 | G | 8 | 2 | ¾ | 2 | Carbondite. | Mommert, Wolf & Dixon grinder. | Chisels. | Pattern shop. |
| 41 | A | 3½ | ¼ | ⅜ | 1 | Carbondite. | Mommert, Wolf & Dixon grinder. | Gouges. | Pattern shop. |
| 42 | A | 3½ | 5/16 | ⅜ | 1 | Carbondite. | Mommert, Wolf & Dixon grinder. | Gouges. | Pattern shop. |
| 43 | A | 3½ | ⅜ | ⅜ | 1 | Carbondite. | Mommert, Wolf & Dixon grinder. | Gouges. | Pattern shop. |
| 44 | A | 3½ | 7/16 | ⅜ | 1 | Carbondite. | Mommert, Wolf & Dixon grinder. | Gouges. | Pattern shop. |
| 45 | A | 3½ | ½ | ⅜ | 1 | Carbondite. | Mommert, Wolf & Dixon grinder. | Gouges. | Pattern shop. |
| 46 | Cone | 3 | 5½ | ... | 1 | Carbondite. | Mommert, Wolf & Dixon grinder. | Gouges. | Pattern shop. |
| 47 | A | 26 | 1½ | 6 | 1 | Emery. | Woods knife grinder. | Planer knives. | Planing mill. |
| 48 | B | 10 | ½ | 15/16 | 1 | Carbondite. | Covel saw grinder. | Wood saws. | Planing mill. |
| 49 | B | 10 | ⅜ | 15/16 | 1 | Carbondite. | Covel saw grinder. | Wood saws. | Planing mill. |
| 50 | A | 10 | ¼ | 15/16 | 1 | Carbondite. | Covel saw grinder. | Wood saws. | Planing mill. |
| 51 | H | 18 | 2½ | 8 | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 52 | A | 18 | 2½ | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 53 | A | 12 | 1½ | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 54 | A | 12 | 1¼ | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 55 | A | 12 | 1 | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 56 | A | 12 | ¾ | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 57 | A | 12 | ½ | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 58 | A | 12 | ¼ | 1½ | 1 | Emery. | Bridgeport No. 6 comb. tool grinder. | Wood tools. | Planing mill. |
| 59 | A | 8 | 1 | ⅝ | 1 | Emery. | Double floor grinder. | General use. | Test department. |
| 60 | A | 8 | ¾ | ⅝ | 1 | Emery. | Double floor grinder. | General use. | Test department. |
| 61 | A | 8 | ½ | ⅝ | 1 | Carbondite. | Double floor grinder. | General use. | Test department. |

directly in front in plain view of operator as shown in the illustration.

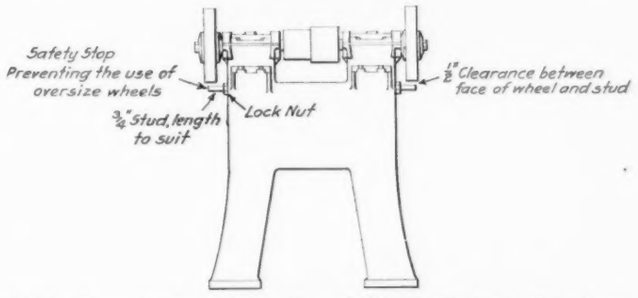
*Dressing Wheel:* Keep the wheel running true by frequent dressing. This should be done at least once each week. Workmen are to notify the foreman when a wheel needs dressing.




Scale for Grade of Wheels.

*Care of Journals:* Journals should be carefully adjusted to prevent vibration. If not carefully watched, lost motion will ruin the journals and burst the wheels. Journals should be kept well lubricated to prevent running hot, as the expansion of the spindle may burst the wheel.

*Protection Hoods:* All grinding wheels over 8 in. diameter must be protected by suitable hoods made of either cast iron or steel plates to cover sides and edges of wheel, except at working points, as is shown in one of the illustrations.


Safety Stop Preventing the use of oversize wheels
3/4" Stud, length to suit
Lock Nut
1/8" Clearance between face of wheel and stud

Safety Stops to Prevent the Use of Wheels That Are Too Large.

*Protection Shields:* Glass protection shields should be used wherever possible. A leather spark brush can sometimes be used instead.

*Use of Wheels Without Hoods:* When it is necessary to use grinding wheels over 8 in. in diameter without protection hoods, the maximum amount of wheel that should project beyond the edge of flange is 2 in. This will necessitate the use of several sizes of flanges as the wheels wear down.

SAFETY FIRST
MACHINE Nº ------
SPINDLE REV. PER MINUTE ------
DIAMETER OF NEW WHEEL -----INCHES
TAKE OFF WHEEL AT ----- INCHES
NOTIFY FOREMAN WHEN WHEEL NEEDS DRESSING.

*This notice to be placed on all grinding machines. Letters white on red back ground. Painted on tin, at least 7" x 12". Letters at least 3/8" in height with 3/8" spacing between lines.*

Notice to Be Hung on Machines.

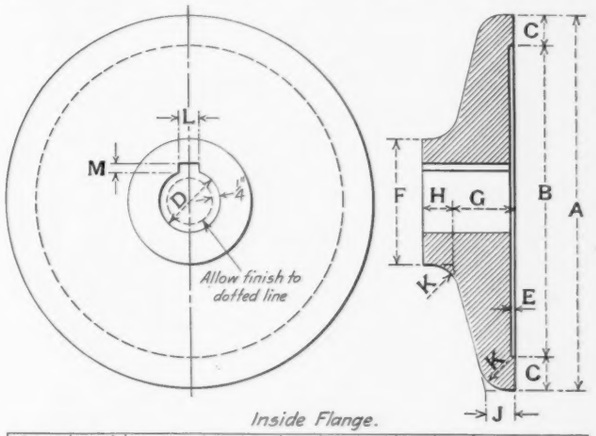
*Use of Wheels:* Always use the face of grinding wheels, for grinding any kind of work.

*Rests:* All rests must be kept adjusted as close as possible to the wheel, and should not be more than ¼ in. away from it.

*Use of Goggles:* When it is not practicable to use protection shields, all grinding wheel operators should be required to wear goggles.

*Wet Grinding:* Grinding Wheels used in wet grinding must never be left over night partly immersed in water.

*Rules for Calculating Speed and Diameter of Pulleys:* Speed of grinding spindle being given to find the proper speed for the countershaft: Multiply the number of revolutions a minute of the grinding spindle by the diameter of its pulley, and divide this product by the diameter of the driving pulley on the countershaft.

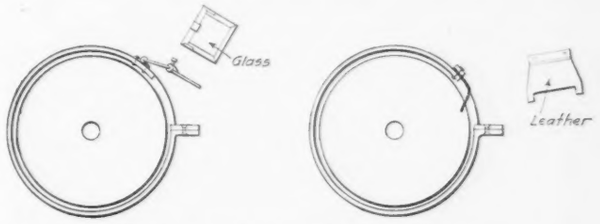



| Diameter of Wheel | A | B | C | D* | E | F | G | H | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8" | 4" | 3 1/8" | 7/16" | 3/4" | 1/16" | 1 1/2" | 3/4" | 3/8" | 3/8" | 3/8" | 9/32" | 3/32" |
| 12" | 6 | 5 | 1/2 | 1 | 1/16 | 2 | 1 | 1/2 | 1/2 | 1/2 | 5/16 | 7/64 |
| 18" | 9 | 7 1/2 | 3/4 | 1 1/4 | 1/16 | 3 1/2 | 1 1/4 | 7/8 | 7/8 | 7/8 | 7/16 | 5/32 |
| 24" | 12 | 10 | 1 | 2 | 1/8 | 4 | 2 | 1 | 1 | 1 | 1/2 | 5/32 |
| 30" | 15 | 12 1/2 | 1 1/4 | 2 1/2 | 1/8 | 5 | 2 1/2 | 1 1/2 | 1 1/4 | 1 1/4 | 5/8 | 3/16 |
| 36" | 18 | 15 | 1 1/2 | 3 | 1/8 | 6 | 3 | 1 1/2 | 1 1/2 | 1 1/2 | 11/16 | 7/32 |

* Bore Flange to Suit Shaft to Which Applied.

Recommended Inside Flange.

Speed of countershaft being given to find the diameter of pulley for the line shaft: Multiply the number of revolutions a minute of the countershaft by the diameter of the tight and loose pulleys, and divide the products by the number of revolutions a minute of the line shaft.




Protection Shields for Grinding Wheels.

The speed of countershaft being given to find the diameter of pulley to drive the grinding spindle: Multiply the number of revolutions a minute of the grinding spindle by the diameter of its pulley, and divide the product by the number of revolutions a minute of the countershaft.

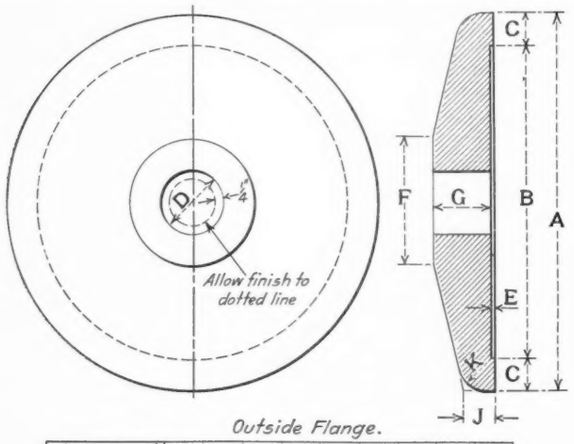
General principle used to determine speeds in diameters: The diameter of any driven pulley multiplied by its speed always equals the diameter of the driving pulley multiplied by its speed.

To find the surface speed in feet per minute of any grinding

wheel: Divide the number of revolutions of the wheel by 12, and multiply the result by 3.1416 times the diameter of the grinding wheel.

*Accident Prevention:* It is the desire of the management to reduce the number of accidents to a minimum, and it will be the duty of master mechanics and foremen to personally see that these instructions are strictly carried out in connection with all grinding wheels under their supervision.

*Report of Accidents:* In addition to any instructions covering




Outside Flange.

| Diameter of Wheel | A | B | C | D* | E | F | G | J | K |
|---|---|---|---|---|---|---|---|---|---|
| 8" | 4" | 3 1/8" | 7/16" | 3/4" | 1/16" | 1 1/2" | 3/4" | 3/8" | 3/8" |
| 12" | 6 | 5 | 1/2 | 1 | 1/16 | 2 | 1 | 1/2 | 1/2 |
| 18" | 9 | 7 1/2 | 3/4 | 1 3/4 | 1/16 | 3 1/2 | 1 3/4 | 7/8 | 7/8 |
| 24" | 12 | 10 | 1 | 2 | 1/8 | 4 | 2 | 1 | 1 |
| 30" | 15 | 12 1/2 | 1 1/4 | 2 1/2 | 1/8 | 5 | 2 1/2 | 1 1/4 | 1 1/4 |
| 36" | 18 | 15 | 1 1/2 | 3 | 1/8 | 6 | 3 | 1 1/2 | 1 1/2 |

* Bore Flange to Suit Shaft to Which Applied.

**Recommended Outside Flange.**

regular accident reports now in force, a complete report of all accidents caused by use of grinding wheels must be made immediately to the office of the mechanical engineer, stating the nature of injury, the probable cause, the speed at which wheel was running, and whether all details of these instructions were carried out.

## SHOP OUTPUT*

BY J. H. TINKER,
**Superintendent of Motive Power, Chicago & Eastern Illinois, Danville, Ill.**

Shop efficiency or output must be based on some uniform method and a great number of things must be taken into consideration before it is possible to fairly compare the output of different shops. Otherwise there is a possibility of considerable misunderstanding. Suppose a superintendent of motive power compared the output of his shops with the output of the shops of a superintendent of motive power of another road whose figures were not nearly as large, what would the latter do? He would naturally call on his master mechanic or shop superintendent for an explanation as to why he could not do as well as his neighbor. The shop officials would probably be criticized and placed in an embarrassing position while in reality they might be getting 100 per cent. efficiency from the shop and men. If a detailed comparison or some uniform method of showing the output was adopted by these two roads, the output would, no doubt, be on a par with the shop with which the comparison was made.

When making comparisons of this kind the following items should be considered: The general lay-out of the shops and machinery; the number of men employed in all of the shops (average per pit); the number of pits operated; the average number of machines per pit; the amount of finished stock material; the facilities and method of handling; the class of repairs; the size or tractive power of the locomotives; the organization; and the wage system, whether piece work or day work.

Taking the majority of the above items for a basis to work from, the following statement was prepared showing the number of locomotives turned out of Oaklawn shops, at Danville, Illinois, for the years 1912 and 1913, taking into consideration only classes 1, 2 and 3 repairs:

MONTHLY EFFICIENCY OF OAKLAWN SHOPS.

| Month and Year. | Class number of repairs. 1 | 2 | 3 | Total | Tractive power in thousands of pounds. Class No. of repairs. 1 | 2 | 3 | Total T. P. output per month. | Number of men employed. | No. of men per 1000 lb. T. P. outp't | Number of pits operated. | Number of engines per pit operated. | Number of men per pit operated. | Number of men per engine output. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan., 1912.. | 4 | 11 | 3 | 18 | 119 | 356 | 95 | 570 | 682 | 1.19 | 16 | 1.20 | 42.6 | 37.9 |
| Jan., 1913.. | 1 | 5 | 10 | 14 | 32 | 118 | 297 | 447 | 607 | 1.35 | 15 | .93 | 40.4 | 43.3 |
| Feb., 1912.. | 6 | 9 | 7 | 22 | 189 | 304 | 200 | 693 | 699 | 1.01 | 15 | 1.46 | 46.6 | 31.8 |
| Feb., 1913.. | 2 | 9 | 6 | 19 | 50 | 332 | 197 | 569 | 622 | 1.09 | 15 | 1.13 | 41.4 | 36.6 |
| Mar., 1912.. | 4 | 10 | 4 | 18 | 108 | 324 | 109 | 541 | 550 | 1.02 | 13 | 1.38 | 42.3 | 30.6 |
| Mar., 1913.. | 1 | 8 | 8 | 17 | 25 | 206 | 281 | 602 | 602 | 1.00 | 14 | 1.21 | 43.0 | 35.4 |
| April, 1912. | 0 | 1 | 1 | 2 | 0 | 38 | 25 | 63 | 250 | 4.00 | 4 | .50 | 62.5 | 125.0 |
| April, 1913. | 5 | 6 | 6 | 17 | 156 | 200 | 183 | 542 | 668 | 1.23 | 13 | 1.30 | 51.4 | 39.3 |
| May, 1912.. | 0 | 1 | 4 | 5 | 0 | 15 | 125 | 140 | 265 | 1.90 | 4 | 1.25 | 66.1 | 53.0 |
| May, 1913.. | 6 | 5 | 4 | 15 | 181 | 199 | 105 | 465 | 585 | 1.26 | 14 | 1.07 | 41.8 | 39.0 |
| June, 1912.. | 1 | 3 | 3 | 7 | 25 | 112 | 100 | 237 | 444 | 1.87 | 9 | .77 | 49.3 | 63.4 |
| June, 1913.. | 7 | 4 | 7 | 18 | 251 | 149 | 300 | 700 | 620 | 0.88 | 16 | 1.12 | 38.8 | 34.4 |
| July, 1912.. | 3 | 9 | 4 | 16 | 73 | 276 | 129 | 478 | 712 | 1.50 | 19 | .84 | 37.5 | 44.5 |
| July, 1913.. | 6 | 5 | 11 | 22 | 183 | 169 | 457 | 809 | 750 | 0.92 | 22 | 1.00 | 34.1 | 34.0 |
| Aug., 1912.. | 7 | 8 | 5 | 20 | 206 | 293 | 188 | 687 | 713 | 1.03 | 19 | 1.05 | 37.5 | 35.6 |
| Aug., 1913.. | 6 | 11 | 8 | 25 | 191 | 409 | 383 | 983 | 819 | 0.83 | 23 | 1.09 | 35.6 | 32.7 |
| Sept., 1912. | 4 | 6 | 2 | 12 | 125 | 183 | 76 | 384 | 676 | 1.60 | 14 | .86 | 44.0 | 51.3 |
| Sept., 1913. | 4 | 8 | 13 | 25 | 113 | 269 | 495 | 877 | 825 | .94 | 23 | 1.09 | 35.9 | 33.0 |
| Oct., 1912.. | 3 | 7 | 5 | 15 | 83 | 226 | 128 | 437 | 572 | 1.30 | 13 | 1.15 | 44.0 | 38.3 |
| Oct., 1913.. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Nov., 1912.. | 1 | 6 | 5 | 12 | 17 | 183 | 162 | 362 | 572 | 1.44 | 12 | 1.00 | 43.5 | 43.5 |
| Nov., 1913.. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |
| Dec., 1912.. | 6 | 5 | 7 | 18 | 147 | 173 | 206 | 526 | 566 | 1.07 | 13 | 1.38 | 43.5 | 31.4 |
| Dec., 1913.. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. |

The following is our repair classification list:

*Class* 1.—New boiler or fire-box complete, new flues and general repairs to the machinery.

*Class* 2.—Heavy repairs to the machinery, flues reset, one-half side sheets, new front and back flue sheet, new crown or door sheet, tires new or turned.

*Class* 3.—Light repairs to the machinery, flues new or reset, tires new or turned.

*Class* 4.—Covers all repairs not included in Classes 1, 2 and 3, where expenses for labor and material exceed $125.

*Class X.*—Covers accident repairs and may be used in connection with Classes 1, 2, 3 and 4, or separately when the repairs made include the damaged parts only.

Any repairs made where the expense for labor and material is less than $125 are considered "Running Repairs," including new patches on the side of the flue sheet not considered in Class 2 repairs, and new extension front ends not considered under Class 2 repairs.

Class 4 repairs have not been taken into consideration, yet a number of this class of repairs were turned out where the cost would run from $600 to $800 on account of the engine meeting with an accident immediately after receiving general repairs and could not be classified otherwise, not receiving new boiler, fire-box or flues. The average number of engines turned out of the shop for Class 4 repairs is about eight per month.

In analyzing the output at the Oaklawn shops it will be noticed that for the month of August, 1913, there is an increase over the corresponding month a year ago of 25 per cent. (43 per cent. increase in tractive power) with only 14 per cent. increase in men employed, 21 per cent. in pits operated and 37 per cent. in engines per pit, with an increase of only a fraction of over 3½ per cent. in the shop payrolls. This increase in output has been accomplished by the methods as later explained.

A shop schedule or accounting system will increase shop effi-

*Abstract of paper presented at the November meeting of the Western Railway Club.

ciency. It has not been tried on our road other than to set an estimated date for the engine to be completed, painting this date on a board and hanging it on the engine, so that each foreman will know when the engine is expected to go out. The work is specialized as much as possible. The shops also get out all finished parts, such as driving boxes, shoes and wedges, flues, etc., for all the roundhouses on the system where there are no machines. All repair parts are furnished from the Danville shops. The back shop forces also handle the repairs to all stationary boilers, pumps, air compressors, etc., on the system, as well as handing derrick cars, Lidgerwoods, steam shovels, gravel spreaders and center plows. In addition, all tools and other machinery are sent to these shops for overhauling. All jacks, air tools, etc., for the entire system are repaired at Danville and the statement shown above includes all men employed. If such employees as handle this special work had been deducted the number of men per pit would be considerably less than that shown.

Efficiency means a great deal more than eliminating lost motion. A man may become so mechanical that he is useless along other lines. The output of a shop depends greatly upon the system of handling, and most any system is good that cuts out lost motion or duplication of work, following the different parts through the various departments, etc. However, the conditions in one shop might be so different from those in another that a system adopted in the one would not be effective in the other.

The following is a synopsis of the movement of an engine through our shops:

1. Engines are reported for the back shop by the division master mechanic for the class of repairs that are needed, and a work report is furnished the superintendent of motive power, covering the general condition of the engine, and he in turn sets the date he is ready to accept the engine for repairs.

2. Engine arrives at shop; if under steam, the fire is knocked out, the cinders dumped and the engine thoroughly blown off by air on the pit before it is taken in the shop. All the tools are removed and stencilled, and are replaced on the engine when it is repaired.

3. The tank is disconnected from the engine and sent to the power house, where the coal is unloaded and used for stationary boiler purposes; it is then turned over to the tank shop for repairs.

4. The engine is thoroughly inspected and all missing, broken or worn out castings are reported to the shop superintendent, who in turn furnishes the store department with material cards covering all the material that is needed to make these repairs. These cards designate where this material is to be delivered, *i. e.*, to what machine, etc. These cards are dropped in a box provided for this purpose, and are gathered by the store department twice each day and the material is sent directly to the machine where it is to be finished, thereby avoiding unnecessary handling.

5. The engine is taken in the shop and stripped, the parts being placed outside of the shop in front of the pit. We have four gains of six pits each in the machine shop. The gang foreman is advised as to the class of repairs the engine is to receive.

6. The gang foreman notifies the stripping gang, which is composed of two machinists and four helpers, as to the amount of stripping the engine is to receive. The stripping gang raises and blocks all engines, cleans all of the work and delivers the different materials to the various shops or special benches where the work is to be done.

7. After the engine has been placed on blocks the steam pipe gang removes the front end, dome cap and stand pipe. The flues are removed and sent to the flue cleaning shed to be repaired; the boiler is also thoroughly inspected for cracks and the flue sheets are examined.

8. All driving boxes are delivered to a special gang, where they are thoroughly inspected and repaired, re-brassed, planed and bored, ready for fitting to the journals. All driving box work is handled in one end of the shop, where the machinery for completing the boxes is located, and the boxes are passed along from one machine to another until finally completed. The gang foreman is then notified that the boxes are ready for fitting and mounting on the wheels.

9. The links and all the motion work are delivered to a special link gang, where the repairs are made so that the parts are completed ready for application to the engine. Special machinery for this work is located near the link gang.

10. All throttle rigging, steam pipes, steam-pipe joints, stand pipes and valves are taken to a special steam pipe gang, where they are thoroughly ground and repaired ready for use.

11. The rods, pins, collars and brasses are all delivered to a special rod gang located near the center of the shop, where the machinery adapted for repairing rods is located. This gang is provided with three air hoists (which cover their entire space) for handling the rods from one bench to another.

12. All wheels are thoroughly inspected; the pins and journals are calipered to determine if they will finish to a special size below the original (which on the axles is 3/8 inch below original size, and on the crank pins 3/16 in. below). These wheels are then removed to the quartering machine, where they are examined for the quarter and the stroke; if the pins are found to be out they are removed. If found to be only out of round from wear they are turned true, while on the quartering machine, by a special attachment. We, therefore, have our wheels in perfect quarter and stroke. The rods are all bored to fit the pins. After the wheels are quartered they are removed to the journal turning machine, where all the journals are tried for "true"; if not true they are turned and rolled. We do this work on an old wheel lathe that has been converted into a journal turning lathe by removing one face plate from the machine and using the other face plate for the driving pulley. Both journals are turned at the same time, and then rolled. We feel that our wheels come as near being perfect in quarter and stroke as it is possible to make them. The handling of these wheels is all done with our under-traveling crane, which places the wheels on the different machines.

13. After the wheels and all the material have been removed from the engine, the frames are placed on blocks, where they are thoroughly cleaned and white-washed so that any cracks in them may be detected.

14. Should the engine be in need of a new fire-box, it is taken to the boiler shop, the transfer being made by a transfer table. Another engine, in for general repairs, and which is to be out the same month, is then placed on the vacated pit.

15. All jacket work and pipe work is removed and delivered to the tin shop for renewal or repairs, each piece being stencilled or tagged, designating the engine to which it belongs.

16. All lagging is removed and put in bundles, properly tagged and taken to a shed for safe keeping, to be re-applied when needed. Old or broken pieces of lagging are put in a vat and steamed to a pulp and used again around flexible staybolt caps or places where a large piece of lagging cannot be used.

17. All cab trimmings and injectors are removed and taken to the brass room, to be either repaired or replaced.

18. All steam gages, governors, pops and air pumps are removed and placed in the air room, where they are repaired and tested. The pumps are given a working test before being reapplied. The pops are set by air pressure and tested by a gage. In addition the safety valves are set to the proper pressure upon the boiler, in accordance with the Interstate Commerce Commission requirements.

19. Cab, running-boards and pilot are removed and delivered to the cab department in the tank shop, where proper repairs are made and where they are painted before returning.

20. The engine has now been in the shop a sufficient length of time to have such work as the jaws filed, the spring rigging repaired, the shoes and wedges laid off and the boxes fitted, and the engine is ready to wheel. The engine is raised by an electric crane; the wheels are rolled under it and the shoes, wedges and binders are replaced. In the meantime the flues are being put in the boiler, all the cocks in the cab, and the washout plugs and dome caps applied, all of these being replaced by the time that the flues have been reported ready for test. A boilermaker then inspects the fire-box and boiler in accordance with Interstate Commerce rules and pronouncing the boiler work O. K., the gang foreman orders the lagging, jacket and cab replaced, also all the trimmings, injectors, etc. The rod foreman then applies the main rods so that the rollers can be placed under the engine for setting the valves; after this is done the parallel rods are applied, and the painter foreman is notified that the engine is ready for painting. After being painted, the engine is removed from the back shop to the roundhouse, where the tank is applied, and the roundhouse foreman is notified that it is ready to be fired up for the break-in trip.

21. The engine is turned over to the engine "tamer," who gives it a thorough inspection and breaking-in, reporting any defects or unfinished work to the shop superintendent, who has a special gang to look after this. The engine is then sent out on a break-in trip and if any defects develop the shop superintendent is again notified and sends his force to make the repairs. After these repairs are made the engine is turned over to the division to which it is assigned.

The output of a shop, of course, depends a great deal upon the organization. The operating conditions on the Chicago & Eastern Illinois (like a good many other railroads) the last six or seven years have been very disastrous to the shop organizations. It has been necessary to reduce the forces almost every year and in a great many cases the shops have been closed entirely on account of depression in business, and every time this is done the efficiency of the organization is lost and some of the best mechanics in the country have left the shops on account of the fluctuation in working conditions. In opening up the shops again it has been necessary to hire almost any one that comes along representing himself to be a mechanic. A great number of these men only work a sufficient length of time to get a "stake," which makes a condition that is hard on any kind of an organization. It has been found necessary at times to hire on an average of 25 men a day at the Danville shops in order to keep the force of men at a given number.

Taking it for granted that a man is a good mechanic, he will not develop to 100 per cent. efficiency to the company until he has been in the service a certain length of time, say one or two months, as there will be conditions with which he is not familiar and it takes time to educate him.

In addition, mechanical departments have experienced in the past a great many delays on account of shortage of material. This is not a reflection on the stores department but due to the fact that retrenchments were necessary and they could not order material far enough in advance to prevent shortages when the shops were again opened up.

It would be difficult to estimate the loss to any railroad company due to such fluctuation in working conditions. If the conditions would permit of working the shops uniformly the year around, the railroads would effect a great saving, and at the same time have the power in good condition, or comparatively so, all the time; in this way the mechanical department could figure on a certain number of engines falling due for the shop each month, whereas, during the past several years, the greater proportion of heavy locomotives has been put through the shops during the months of August, September, October, November and December, which in the regular order of events, makes them all fall due about the same time the following year, and this is a condition that works hardships on the mechanical and operating departments. The necessity of retrenchment curtailing the output of a shop in the summer months, prevents the repairs to other locomotives in the same class, making a shortage of power and congestion, which would make it inadvisable to shop these engines when due. To relieve a situation of this kind, it is occasionally necessary to advance the regular date of shopping to prepare the heaviest power for the service in winter months, and this necessarily increases the maintenance cost, also necessitates engines continuing in service longer than their condition would warrant, probably decreasing the miles run per failure, and unless these conditions are fully considered it is hard to get a fair comparison.

DISCUSSION.

A. R. Kipp, mechanical superintendent, Chicago division of the Soo Line, stated that the size of power and the grades over which the engines operate were features that must be considered when comparing shop output. For this reason the miles run or the ton miles would not be a fair basis on which to compare. He believed that by taking an average tractive effort unit, say 20,000 lbs. for example, and reducing other roads to that unit, that more comparable information could be obtained. If one road had an average tractive effort of 30,000 lbs., their factor would be 1.5, while another having an average tractive effort of 40,000 lbs. would have a factor of 2, and by reducing the output from average tractive effort down to one, the comparison would probably be as near as could be made.

The question was raised as to the method of inspecting crank pins and journal bearings. It was stated that in France this is done by washing the bearing surface carefully with kerosene, and placing the wheels on a track where they are run against each other at a speed of five or six miles an hour. In this way the jar will show the surface cracks by forcing the oil out of them showing a distinct line. It was also stated that in Europe considerable time had been saved in fire-box repairs by having extra sets of complete back ends so that when an engine was shopped for new fire-box sheets the whole back end could be substituted with the one held in stock; the old back end being repaired and held ready for another engine.

Mr. Tinker, in his closing remarks rather questioned the advisability of using any definite unit in comparing shop output, as there were so many different things to be considered, and the practice of the different shops varied to such an extent. He stated that the crank pins on his engines are carefully tested by wiping them with oil, and hitting them on the end with a sledge, believing that they would in this way show up the surface cracks as well as if they were run together, as stated above. Some roads remove the crank pins every five years, but he did not believe this was necessary, as the tests and the calipering would be sufficient test. As regards the replacing of the entire back ends, he stated that he had found this impossible to do, even with engines of the same class and in the same consignment, as they vary to such an extent that no two back ends were exactly alike.

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Soapstone Production.—The production of soapstone in the United States in 1912 was greater than that of any other country, and also greater than that of all other countries combined, amounting to 25,981 tons.

Chili and International Railways.—The Chilian minister of industry recently announced in the Senate that the government would give no facilities for the construction of international railways as long as no commercial treaties between Chili and the neighboring countries existed.

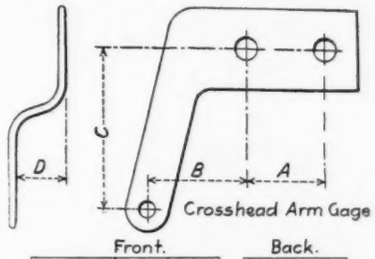
Rust Caused by Paint.—Among the results of the experiments recently made by the German naval authorities for the purpose of finding some means of preventing the rusting of ships' plates was the discovery that in some cases color intended as a protection actually caused rust.—*The Engineer.*

# WALSCHAERT VALVE GEAR GAGES

## Accuracy in Machining Parts Will Make Later Setting Unnecessary. Instructions for Checking.

BY C. T. ROMMEL

It is an easy matter to lay out a Walschaert valve gear for each class of locomotive and locate any inherent defect in the design which can then be readily corrected. If after this is done, gages are made it will be possible to so construct the gear that practically no valve setting will be necessary after it is applied to the locomotive. By the use of the gages each man working on any part of the gear does his share toward the correct setting of the valve.




Crosshead Arm Gage

| Class | Front A | Front B | Front C | Front D | Back A | Back B | Back C | Back D |
|---|---|---|---|---|---|---|---|---|
| A-3 | 3 5/8 | 3 | 11 1/8 | 4 | | | | |
| E-27B, E-27C | 4 3/4 | 3 3/4 | 11 | 4 1/2 | | | | |
| Q-1, Q-1A, Q-1B P-1, P-1A | 4 3/4 | 1 1/2 | 10 1/8 | 3 3/4 | | | | |
| 0-1 | 3 | 5 1/2 | 11 | | | | | |
| 0 | 3 3/4 | 4 | 9 3/4 | 2 1/4 | | | | |
| 0-0DD | 4 1/2 | 3 3/4 | 12 3/4 | 3 5/8 | 4 3/8 | 3 3/4 | 8 3/8 | 3 5/8 |
| C-16 | 4 1/4 | 1 7/8 | 6 1/8 | 2 3/4 | | | | |

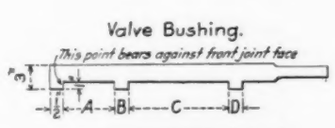
In the system which the writer has perfected, the gages are used for locating the spacing of the ports in the valve bushing, the width and spacing of the valve packing ring, the length of the valve stem and rod, the link, crosshead arm, radius bar, combination lever, union link and the location of the eccentric crank arm. These various gages are shown in the illustration with tables of dimensions as required for various classes of locomotives on the Baltimore & Ohio.

After the gear is assembled on the locomotive and it is known that all the parts for which gages are provided are correct, it only remains to find the correct length of the eccentric rod and of the reach rod which can be done in one revolution of the wheels. This system eliminates any necessity of obtaining centers and will give an absolutely correct steam distribution. It is advisable to place some distinguishing mark on the locomotive indicating that all parts of the valve gear have been made correct with the gages, as in this way any trouble thereafter developing with the valve gear can be easily located and overcome.

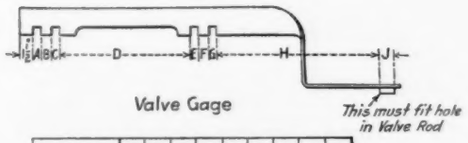
In connection with these gages the following simple instructions are all that are required to be issued to the valve setters.

INSTRUCTIONS.

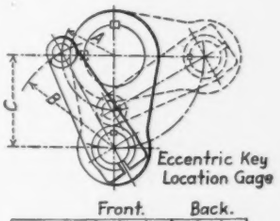
It having been determined that the Walschaert valve gear is finished and assembled according to the gages, the motion will be square and give an equal steam distribution at all points



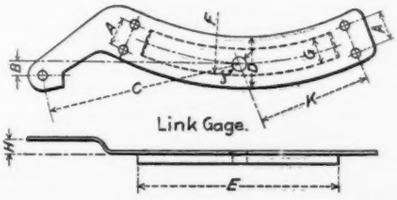

| Class | A | B | C | D |
|---|---|---|---|---|
| A-3 | 7 1/4 | 1 3/4 | 24 | 1 3/4 |
| E-27B, E-27C | 7 7/8 | 1 3/4 | 27 3/4 | 1 3/4 |
| P-1, P-1A, Q-1, Q-1A, Q-1B | 7 1/4 | 1 3/4 | 24 | 1 3/4 |
| 0-1 | 10 5/16 | 2 1/16 | 19 1/4 | 2 1/16 |
| 0 | 8 3/4 | 1 3/4 | 21 | 1 3/4 |
| 0-0DD | | | | |
| C-16 | 7 1/8 | 1 5/8 | 14 3/4 | 1 5/8 |



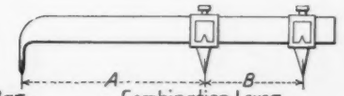

| Class | A | B | C | D | E | F | G | H | J |
|---|---|---|---|---|---|---|---|---|---|
| A-3 | 3/4 | 1/4 | 3/4 | 22 | 3/4 | 1/4 | 3/4 | 48 3/4 | 1 3/4 |
| E-27B, E-27C | 5/8 | 1 1/2 | 5/8 | 24 3/4 | 5/8 | 1 1/2 | 5/8 | 30 7/8 | 1 3/4 |
| Q-1, P-1, P-1A, Q-1A, Q-1B | 3/4 | 1/4 | 3/4 | 22 | 3/4 | 1/4 | 3/4 | 38 7/8 | 1 3/4 |
| 0-1 | 5/8 | 1 1/2 | 5/8 | 16 1/4 | 5/8 | 1 1/2 | 5/8 | 33 | 1 3/4 |
| 0 | 7/8 | 1 3/8 | 7/8 | 17 3/4 | 7/8 | 1 3/8 | 7/8 | | |
| 0-0DD | | | | | | | | | |
| C-16 | 5/16 | 1 1/4 | 5/16 | 13 | 5/16 | 1 1/4 | 5/16 | 26 3/4 | 1 1/2 |




| Class | Front A | Front B | Front C | Back A | Back B | Back C |
|---|---|---|---|---|---|---|
| A-3 | 8 9/16 | 16 | 13 | | | |
| E-27B, E-27C | 8 3/4 | 17 7/8 | 15 | | | |
| Q-1, Q-1A, Q-1B P-1, P-1A | 8 3/8 | 18 1/8 | 16 | | | |
| 0-1 | 7 1/2 | 17 3/4 | 16 | 7 3/4 | 17 1/4 | 16 |
| 0 | | | | | | |
| 0-0DD | | 16 11/16 | 14 | | 15 1/2 | 14 |
| C-16 | 6 7/8 | 14 1/8 | 12 | | | |




| Class | Front A | Front B | Front C | Front D | Front E | Front F | Front G | Front H | Front J | Front K | Back A | Back B | Back C | Back D | Back E | Back F | Back G | Back H | Back J | Back K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A-3 | 3 3/4 | 8 1/2 | 25 | 7 | 24 1/2 | 57 1/2 | 3 | 0 | 3 1/2 | 13 3/8 | | | | | | | | | | |
| E-27B, E-27C | 3 1/4 | 5 | 26 | 6 | 25 | 63 | 2 3/4 | 1 7/16 | 3 1/4 | 14 3/32 | | | | | | | | | | |
| Q-1, Q-1A, P-1, P-1A, Q-1B | 3 3/4 | 8 | 27 | 7 | 24 1/2 | 52 | 3 | 0 | 3 1/2 | 13 3/8 | | | | | | | | | | |
| 0-1 | 3 1/4 | 6 1/2 | 24 | 6 | 25 | 62 | 2 3/4 | 7/16 | 3 1/4 | 12 45/64 | 3 1/4 | 6 3/8 | 24 | 6 | 22 | 66 | 2 3/4 | 7/16 | 3 1/4 | 14 3/32 |
| 0 | 3 | 1 5/8 | 21 1/2 | 6 | 22 1/4 | 52 | 2 3/4 | 0 | 2 1/4 | 12 21/64 | 3 | 1 5/8 | 21 1/2 | 6 | 22 1/4 | 52 | 2 3/4 | 0 | 2 1/4 | 12 21/64 |
| 0-0DD | 3 3/4 | 8 | 24 | 7 | 23 | 70 | 3 | 0 | 3 1/2 | 13 | 3 3/4 | 7 1/4 | 21 | 7 | 23 | 70 | 3 | 0 | 3 1/2 | 13 |
| C-16 | 3 1/2 | 5 1/4 | 20 | 7 | 21 | 52 | 2 3/4 | 0 | 3 | 11 29/32 | | | | | | | | | | |




Radius Bar.

| Class | Front A | Front B | Back A | Back B |
|---|---|---|---|---|
| A-13 | 57 1/2 | 14 | | |
| P-1, P-1A, Q-1 Q-1A, Q-1B | 60 | 13 | | |
| E-27B, E-27C | 63 | 9 | | |
| 0-1 | 61 | 10 | 62 | 10 |
| 0 | 52 | 13 | 52 | 13 |
| 0-0DD | 70 | 11 1/2 | 57 | 13 |
| C-16 | 52 | 11 | | |

Combination Lever

| Class | Front A | Front B | Back A | Back B |
|---|---|---|---|---|
| A-3 | 37 27/32 | 4 1/4 | | |
| E-27B, E-27C | 45 3/8 | 4 1/8 | | |
| Q-1, Q-1A, Q-1B P-1, P-1A | 44 1/8 | 3 3/4 | | |
| 0-1 | 50 | 3 3/8 | 47 15/16 | 4 1/16 |
| 0 | 42 1/16 | 3 | 30 7/8 | 3 3/8 |
| 0-0DD | 49 | 3 1/2 | 39 3/4 | 3 1/2 |
| C-16 | 35 3/4 | 3 1/4 | | |

Union Link.

| Class | Front A | Back A |
|---|---|---|
| A-3 | 11 3/8 | |
| E-27B, E-27C | 21 1/2 | |
| Q-1, Q-1A, Q-1B P-1, P-1A | 10 1/2 | |
| 0-1 | 23 3/4 | |
| 0 | 14 3/8 | |
| 0-0DD | 16 | 14 |
| C-16 | 20 1/2 | |

Gages for Insuring Accuracy In Parts of Walschaert Valve Gear.

of cut-off. The object in issuing these instructions is to simplify the work in the shops and at the same time obtain a correct steam distribution.

After the pistons are applied and the front cylinder heads tightened, the striking points are obtained and marked on the guides so they can be easily seen. The main rods are then applied and made of such a length that the clearance will be equally divided on each end of the cylinder. This is very important if the desired valve movement is to be obtained.

After the main rod has been made the proper length the travel marks are also located on the guides. The port marks are also obtained and marked plainly on the valve stem.

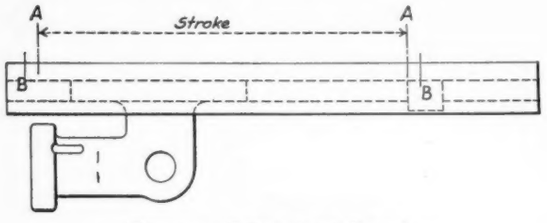
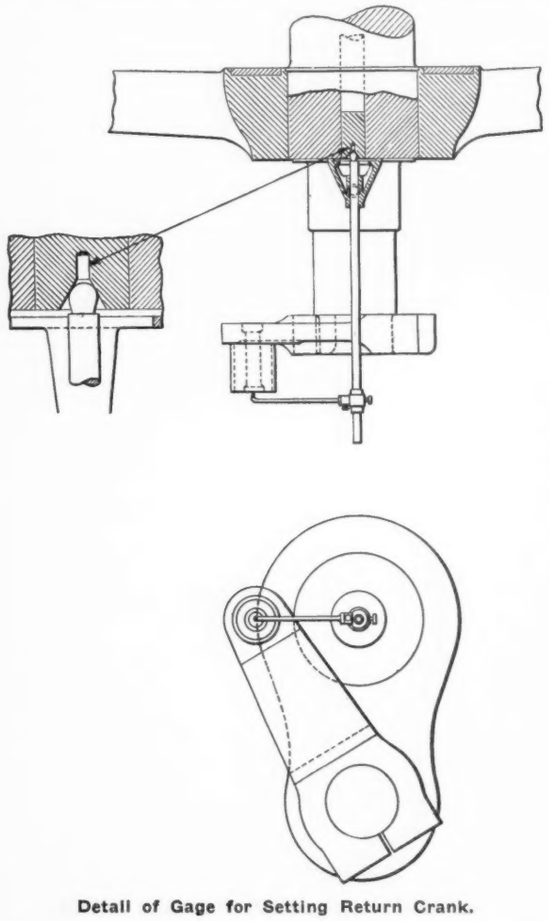



Diagram of Crosshead Travel.

On the diagram of crosshead shown above the travel marks are at A A. The striking points are at B B.

Place the reverse lever in the extreme forward motion and revolve the wheels by moving the engine ahead until the point of cut-off is located at the end of the cylinder then taking



Detail of Gage for Setting Return Crank.

steam. This is obtained by stopping the movement of the wheels at the exact point that the tram cuts the port mark on the valve stem. Measure from the travel mark to the same point on the crosshead from which the travel mark was obtained and note the distance, 22 in. for example. Then revolve the wheels in the same direction until the cut-off is obtained at the opposite end of the cylinder and assume it is found to be 26 in. This indicates that the cut-off is out 4 in., and as all the parts except the eccentric rod have been gaged and are known to be correct, the next step is to obtain the proper length of the eccentric rod.

The cut-off on one end is 22 in., and on the other 26 in. To make this equal it must be $(22 + 26) \div 2$, or 24 in. Set the crosshead at 24 in. from either travel mark, disconnect the eccentric rod, place the tram on the valve stem, and move the link until the tram cuts the port mark, then measure the distance the link has been moved, which will give the necessary change in the length of the eccentric rod. Have these changes made and no further setting is necessary. Both sides of the engine are gone over in this manner. It is not necessary to go over the back motion.

While the wheels are revolving to obtain the cut-off, the maximum valve travel is also obtained to check up the length of the reach rod. The following table shows the lead, lap and valve travel on the different classes of engines.

## AUTOGENOUS WELDING IN LOCOMOTIVE FIREBOXES

BY N. H. AHSIOULH

Autogenous welding has been used in the fireboxes of locomotives with varied degrees of success during the past few years. The difficulty which has been the hardest to overcome, is the fracturing of plates due to the contraction of the cooling parts; the strain produced causes the fracture of adjacent welds or the weld which is cooling. This has been very discouraging and is the primary cause of the very slow progress being made in the application by this method of patches and part sheets to locomotive fireboxes.

It is idle to assume that any flat sheet, stayed rigidly in all directions, can be heated and allowed to cool without leaving a strain in the iron as a result of the cooling off process; much less can we cut a hole of any shape in a side sheet, fit in a flat patch and weld around the four sides successfully. In the few instances where patches of this kind have been considered a success it is because the welded seam was strong enough to withstand the strain. Sooner or later these welds, or the sheets adjacent to them, will show cracks due to this strain. The trend of modern boiler making is toward the making of all parts to fit in their proper places with no unnatural strains anywhere in the boiler. The practice of welding patches and sheets in fireboxes, without means of perfectly compensating for the contraction of cooling autogenous welds, is directly opposed to perfect boiler work. In shops where a study of the means to compensate for this contraction has been made are found the only perfect and successful firebox welds.

In various articles upon this subject in technical journals, the assertion has been made that the success or failure of work of this nature depends entirely on the ability of the operator. In part this is true, but the majority of defective welds are caused by the inability of the workmen to make a patch or a sheet and arrange it for welding, in such a manner that the contraction due to the cooling off process is perfectly compensated for. The writer has had very gratifying success in the application of patches and part sheets to wide fireboxes in oil burning locomotives, operating in alkali water districts, and will endeavor to explain the methods and the preparation of the parts for welding.

Considering first the actual operation of welding, the edges of the sheets are made with a bevel of 60 deg., the bottom edges of the bevels touching, thus giving an opening of 120 deg. This opening is larger than the common practice of 90 deg., for the

reason that the torch flame should be at right angles with the part being heated, and the larger the angle of the opening, the less movement of the torch is necessary to keep it at right angles. This is shown in Fig. 1. To make a successful weld both sides of the V'd portion must be heated uniformly with the flux; this is almost impossible with a 90 deg. opening. This can be proved by breaking such a completed weld when it will be noticed that the flux has fused with only one side of the part, to within approximately ⅛ in. from the face of the sheet,

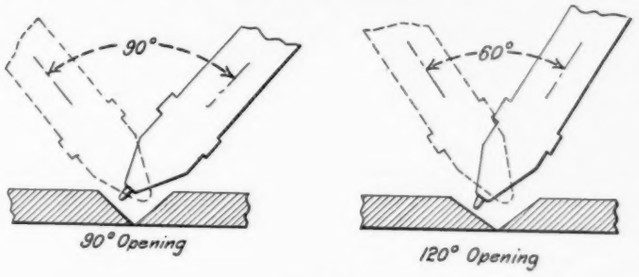



Fig. 1.

and the weld is perfect for the remaining ⅛ in. to the face of the sheet. This is caused by the fact that the nearer the face of sheet, the greater the angle of opening becomes as the weld is made; the greater the angle of opening, the more perfect the weld is. The practice of reinforcing welds in many shops, is proof of the foregoing assertion; this method is to build up the weld ⅛ in. to ¼ in. higher than the face of the sheets adjacent to it. The writer is making perfect welds from the bottom of the V'd parts and finds no reinforcement is necessary where the sheet is welded the full thickness using a 120 deg. opening.

In the operation of welding, the torch flame is rotated in the bottom of the V'd part, heating both sides uniformly until the

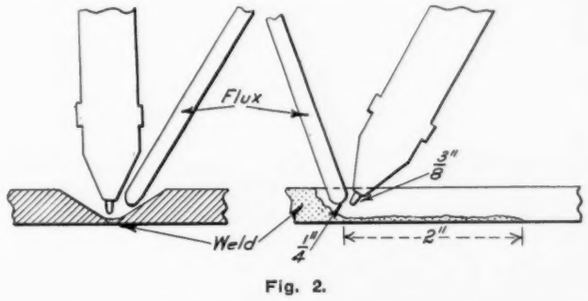



Fig. 2.

metal melts and the edges are fused. Care must be exercised so that the radius of the action of the flame is confined to the very edges of the beveled portions. This is repeated until about 2 in. of the bottom of the V'd part is fused; the stick of flux material, which is ¼ in. round Swedish iron is then brought into play and is held adjacent to the torch flame and allowed to heat uniformly with the sheet; the distances are shown in Fig. 2. When the sheet and flux are heated to the proper amount the flux is placed against the heated sheet and the flame is moved along the sheet slowly for the 2 in. distance, the stick of flux

Fig. 3.

following the flame and melting off enough iron to cover the previously welded portion 1/16 in. thick. The stick of flux is then removed for a few seconds while the burner is slowly moved back over the added material and the edges *A'*, Fig. 3, are smoothed over and welded to the V'd out part. The operation of adding metal is repeated successively for the 2 in. distance, Fig. 3, until the welded portion is flush with the sheet, and the succeding 2 in. distances are welded in the same manner. As the flame will heat the metal to the proper consistency only 1/16 in. deep, care is necessary so that only 1/16 in. is added at a time. The operation of adding only 1/16 in. in conjunction with the heating of the metal to the proper consistency, is the secret of successful autogeneous welding. As the metal gradually heats it approaches the consistency of wax, having a glassy appearance, and this is the proper time to fuse the stick of flux and the sheet; this point is reached just a moment before the metal begins to run. Many operators make the mistake of heating the iron beyond this point to one at which oxidization takes place and little white particles of slag can

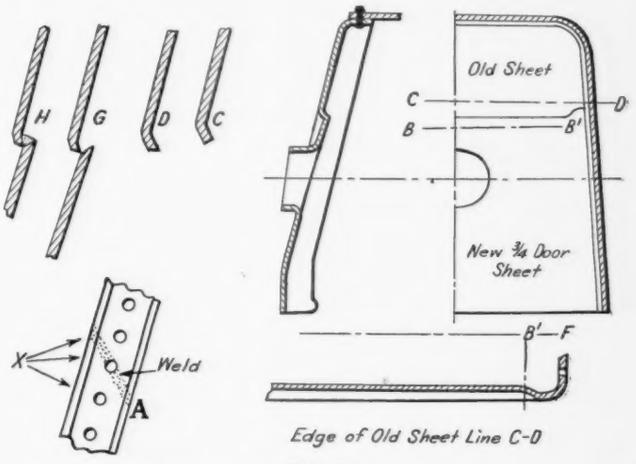



Fig. 4.

then be seen floating in the molten metal; these are the cause of pinholes in the weld after cooling.

A method by which an operator can determine the proper degree of heat at which to fuse the flux and sheet is to make an experimental weld directly overhead, in which case if the sheet is heated too much the iron will melt and drop. By practicing in this manner, successful welds can be made without heating the metals to a temperature which is too high. When heating, it must be borne in mind that the sheet must be at the proper temperature before the metal of the flux is fused with it. The burner flame should be directed on the sheet ¼ in. ahead of the moving stick of flux, to prevent the metal in the

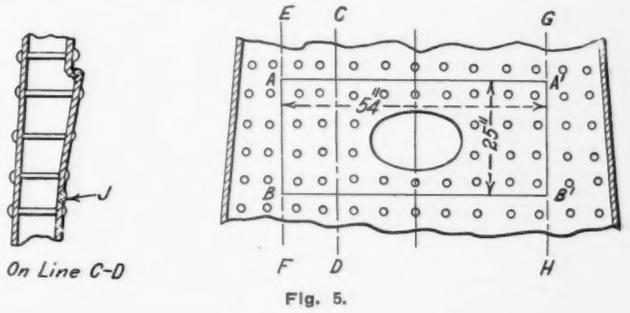



Fig. 5.

flux coming in contact with the sheet when the latter has not the proper degree of heat. On account of the metal in the stick heating more rapidly than the metal in the sheets, it has a tendency to run off on the sheet before the latter has become hot enough to fuse properly. This is a common fault and can be proved by breaking any weld which has proved defective in service; the metal will show in layers which are not fused, proving that the stick was too hot and the metal in the sheet too cold.

The patches and sheets illustrated are all in successful serv-

ice, and have been given no attention whatever since leaving the shop; a large number are in oil burning fireboxes. A door sheet is shown in Fig. 4. This sheet was applied to a wide firebox boiler to change it from two door holes to one. The old sheet was ripped above the door holes and removed, and the side flanges were ripped diagonally as at *A*. The edge of the old sheet from *B* to *B'* was heated by using a flange dog; a 1 in. flange was turned at an angle of 60 deg., as shown at *C;* the edge of the flange was chipped as shown at *D*, and the sides of the new door sheet were heated and set back from *B'* to *F*, thus allowing the sheet to fit along the edge of the flange *D* and also keeping the side flanges lined up properly. From *B'* to *F* and across on the face of the flange *A* the sheet was V'd out on the fire side to a 120 deg. opening, and from *B'* to *B* it was chipped as shown at *G*, this being a reverse bevel.

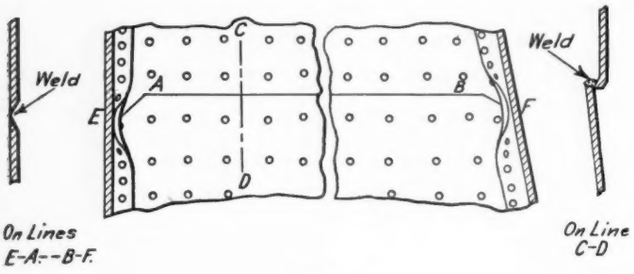



Fig. 6.

From the flange *A* to *B* it was welded on the right and left sides, and from *B* to *B'* was welded as shown at *H*. In this firebox, as no gas was available immediately after the sheet was fitted up and ready to weld, the mudring rivets, flange rivets except those marked *X* and the ashpan work were all finished before the welding of the seams was started. There were no leaks during the hydrostatic test, and none in the door sheet after the locomotive was in service.

A patch on a door sheet which was changed from two door holes to one is shown in Fig. 5. The door sheet was ripped around the two door holes, as shown, and the edge of the opening *A*, *B*, *A'*, *B'* was flanged at 60 deg. and chipped as at *D*, Fig. 4. From *B* to *B'* the edge *J*, Fig. 5, was chipped at an angle of 60 deg.; the perpendicular flanges at *B* and *B'* were

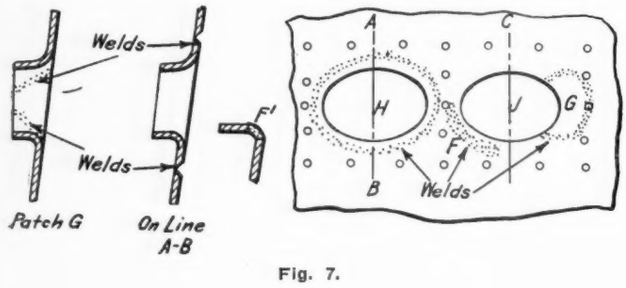



Fig. 7.

tapered from 2 in. above the bottom to meet the sheet flush at the corners. The bottom edge of the patch was chipped at 60 deg. bevel, opening toward the fire, the sides and top being chipped a reverse bevel and fitted up as at *G*, Fig. 4. The first welding was done from *B* to *B'*, raising the patch 1½ in. at *B* to allow for the contraction as the weld cooled. From *B* to *A* was next welded; then from *B'* to *A'*, from *A* to *A'* was welded last. As the opening in the backhead sheet was ripped the same size as in the firebox sheet, the water side of this patch was welded except from *B* to *B'*; this served the purpose also of annealing the previous weld on the fire side. This was a perfectly welded patch, showing no leaks at the hydrostatic test nor in service since.

The renewal of three-fourths of a side sheet is shown in Fig. 6. The old sheet was ripped, leaving 3 in. of each end under the flue and door sheet flanges as shown. One inch of the edge of the old sheet from *A* to *B* was flanged out toward the fire at an angle of 60 deg. and chipped as at *D*, Fig. 4. The flanges of the flue and door sheets were heated and turned at *F* and *E*, to facilitate the operation of welding the ends of the side sheet seam. The new side sheet was laid out and all the holes punched, and the sheet chipped with a reverse bevel from *A* to *B;* the bevel was chipped on the fire side from *E* to *A* and from *B* to *F* and these, being flush welds, were made first. The flanges of the flue and door sheets were heated and turned to their original positions, covering the flush welds. The rivets in the flue sheet and door sheet flanges were next applied and the seams calked; the mudring rivets were applied, and while the work of applying the ashpan was in progress, the weld from *A* to *B* was made; the staybolts were applied last. At the hydrostatic test no leaks developed, nor have there been any in service.

The door sheet shown in Fig. 7 had two door holes, and the one marked *H* had 27 cracks in the knuckle of the flange; an entire door collar was welded in. The weld was 1½ in. from the flange, this short distance compensating for the contraction while cooling. Door hole *J* had ten cracks 1 in. long in the knuckle at *F*. This knuckle was V'd out 1½ in. wide at the top and ¼ in. wide at the bottom, thus removing most of the defective portion of the sheet; the opening was then welded as shown at *F'*. The rivets in the door flange were not removed adjacent to this particular weld. The patch *G* was ripped, as shown in the drawing, using diagonal seams across the flange. This patch was welded with a flush weld, its nearness to the knuckle of the flange compensating for the contraction while cooling, and the diagonal seam compensating for the contraction on the flange. There were no leaks either in the hydrostatic test or in service.

These illustrations cover a wide range of patches or sheets, which could be placed in any firebox. In all of them the contraction of cooling welds is compensated for, either by the location of the patch, by the method of turning out the edges, or by diagonal seams across the flanges. The writer has applied very many more patches and part sheets than those referred to in this article, having only shown enough here to illustrate the methods common to all of this class of work in locomotive fireboxes. All work is tested out with a 10 lb. sledge, and also, wherever possible, by pouring kerosene on one side of the weld in the evening; if the weld is defective the kerosene will be through to the other side of the sheet in the morning. Many failures were experienced while attempts were being made to weld patches in the same plane as the sheet. Since adopting "box" weld to compensate for contraction, perfect results have been the rule, there never having been a leak nor a failure of any sort in this kind of weld.

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CHANGES IN AN OLD BRIDGE.—To accommodate electric power cables which will cross the river Seine on the 300-year-old Pont Neuf, Paris, a trench 4 ft. wide and 7.5 ft. deep is being cut through the solid masonry and flint rock concrete of the bridge structure.—*The Engineer.*

CONTINUOUS BRAKES IN ENGLAND.—As yet the only freight trains in England which are equipped with continuous brakes are what are known as "piped goods," consisting of insulated cars or "wagons." These trains run at a high speed, and their loading is therefore limited.

RAILWAYS AND CANALS.—Canals are necessarily inferior to railways as a means of transport, because their capital cost is higher, their carrying capacity is smaller, they only cater for low-class goods in bulk, and they can only reach the ultimate point of production or consumption by the supplementary use of wagons or railway cars.

# NEW DEVICES

## LINK SIDE BEARING TRUCK

It is claimed by a number of experts on car design that it is advisable to abandon the loaded center plate scheme in car construction, thereby eliminating truck bolsters and center plates, and to carry the load at four points directly to the truck side frames. These men state that it is useless trying to balance a

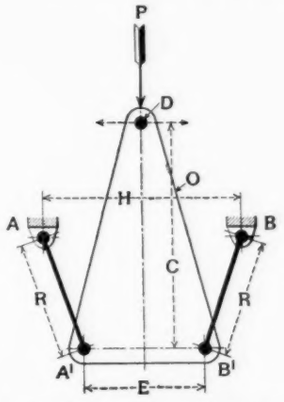



Fig. 1—Diagram of Link Side Bearing.

load of 100,000 to 200,000 lbs. on two central points at each end of the car and on an area so small that a lubricant is hard to retain even were they lubricated. This feature, as well as for avoiding all trouble with side bearings, has led to the design of

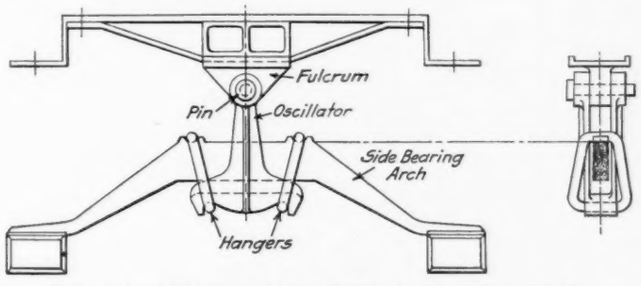



Fig. 2—Application of Link Device to Six-Wheel Truck.

trucks which support the load of the car by links or similar construction on each side frame.*

Fig. 1 illustrates the general principle of a link motion device of this type that has been designed by A. Stoikowitz, of Montreal, Que. *A* and *B* represent fulcrum points for the links *R* which support oscillator *O* at points *A'* and *B'*. Point *D* will travel on a straight line, when certain approximate proportions between the dimensions *R*, *H*, *E*, and *C* are met. The movement of point *D* denotes the side bearing travel which is comparatively small, and as the angular movement of the pivot points is correspondingly small and lever *C* is greater than *R*, the frictional resistance resulting from these points will be small and can be safely neglected. As the load is being carried on what might be called a floating support, the oscillator *O* provides for a nearly frictionless horizontal and radial truck movement on a curve (Figs. 2 and 3), while the links or hangers *R* also allow sufficient lateral movement of the car body, as is the case in a swing motion truck. Furthermore if *D* is pivoted

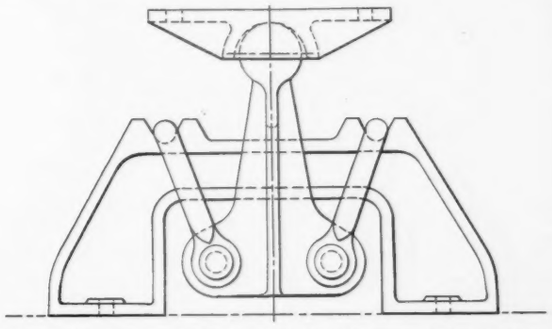


Fig. 4—Link Principle Applied to Ordinary Side Bearing.

to its fulcrum by a pin, it will form an effective anti-telescoping device, as, in case of an accident, it will prevent the cars being lifted from their respective trucks.

Fig. 2 shows the application of this device to a six-wheel passenger truck; the oscillator is U shaped and straddles the side bearing arch as shown; the hangers are of the solid link type and engage both the oscillator and the side bearing arch. The anti-telescoping feature is applied by pivoting the top of the oscillator to the side bearing fulcrum by means of a 2 in. pin. This pin is under double shear and would require an enormous force to tear a truck from its body, provided all the details involved are of equal or greater strength.

Fig. 3 illustrates a standard arch bar truck with bolsters and center plates eliminated and the entire load carried by the side bearings only. A truck swivel plank is substituted for the bolster to provide a swivel point for the truck center. The side bearing fulcrums are riveted to the swivel plank and placed over the truck springs, which arrangement transmits the load directly to the side frames. The king pin hole in the swivel plank

*For description of the Summers side bearing truck see *American Engineer*, April, 1912, pages 193 and 194.

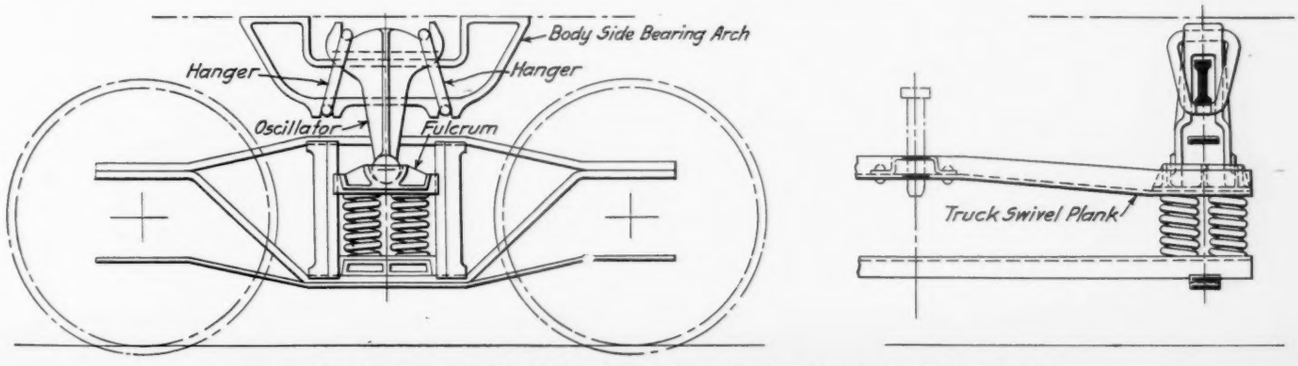



Fig. 3—Standard Truck With Weight of Body Transferred Through the Side Bearings.

is slotted to allow a lateral movement of the car body on the link hangers, thereby embodying the general features of a swing motion truck.

Fig. 4 shows the application of this link motion principle as an ordinary side bearing, which is secured to the truck bolster and intended to replace the common plate or roller side bearing. As dirt has no effect on this side bearing the design can be entirely open; in fact it admits a great variety in the construction of hangers, oscillator or base, depending on the conditions.

In order to prove the theoretical correctness of a bolsterless truck, Mr. Stoikowitz analyzes three cases to which any truck bolster is subjected caused by the different conditions of service. Referring to Fig. 5, there is a clearance between both side bearings; the load is being carried by the center plates only. Undoubtedly this case requires a bolster capable of supporting a concentrated load $P$ at its center and should be sufficiently rigid to maintain clearance $F$ under all conditions of service. As this clearance will vary from ⅛ in. to ½ in., it is evident that the rocking motion of the car body is directly proportional to twice this clearance, which will produce an unfavorable pounding action on side bearings and truck springs.

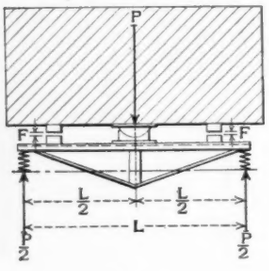


Fig. 5.

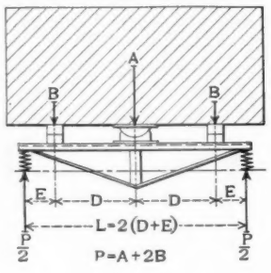


Fig. 6.

Fig. 6 represents a common condition to be found on cars after they have been some time in service and illustrates the obvious uselessness of a bolster strong enough to support a concentrated load. There is no clearance between side bearings, caused either by the deflection of the truck bolster, the body bolster or both, by defective center plates or by many other causes. Evidently this case fails to make use of the total carrying capacity of the bolster in a proportion, as the central force $A$ decreases and the two side forces $B$ increase. As the distance $E$ is small compared with distance $D$, and considering the worst case of $B = \frac{P}{2}$, the resulting bending moment for this point, being $\frac{PE}{2}$, is very small as compared with the bending moment in Fig. 5, which is $\frac{PL}{4}$. But as there is no clearance between the side bearings, the rocking tendency of the car body is greatly retarded or absorbed by the truck springs.

Fig. 7 shows the load unequally distributed and has the same general properties as Fig. 6 with the additional disadvantage of compressing the truck springs unevenly; that is, reaction $R_1$ will be greater than reaction $R_2$. It has been attempted by the use of some cradle arrangement to throw a proportionate part of the load toward the light side, but the theoretical correctness of such an arrangement is questioned; the only remedy is equal distribution of load.

Fig. 8 represents the idea of supporting the load directly over the truck springs, thus eliminating truck bolsters and center plates. As there is no side bearing clearance, the rocking tendency of the car body and the resulting pounding action is greatly retarded. With the load unequally distributed it is equivalent to the case shown in Fig. 7 in compressing the truck springs unevenly, but this condition will happen in exceptional cases only and will have no appreciable effect upon this bolsterless truck.

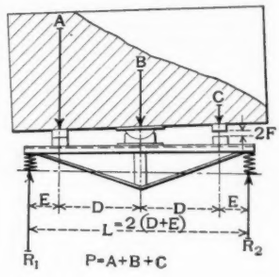


Fig. 7.

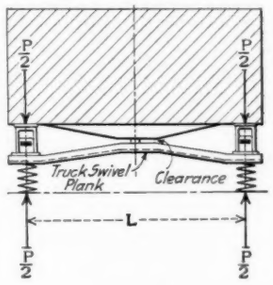


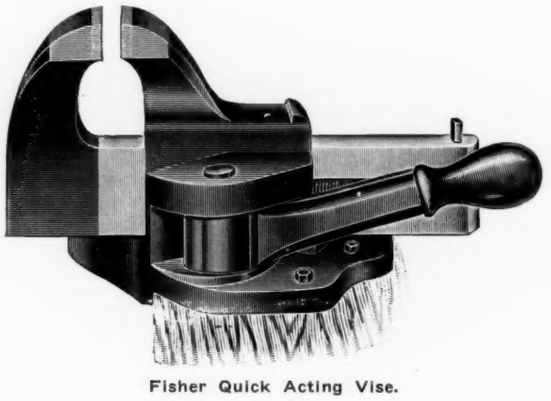
Fig. 8.

Some of the general advantages claimed for this link side bearing in connection with a bolsterless truck are that it solves in a simple manner the side bearing problem, and that when applied to freight trucks it will reduce the dead weight of each car and reduce the wheel flange and rail wear with a corresponding decrease in draft resistance and chance of derailments. When applied to passenger equipment, it gives a nearly frictionless side bearing combined with an anti-telescoping device.

Patents have been applied for on this design by A. Stoikowitz, Montreal. It is manufactured by the Link Side Bearing Company, 314 Hammond building, Hammond, Ind.

## QUICK ACTING LEVER VISE

A new lever vise has been designed by Fisher & Norris, Trenton, N. J. This vise combines quick acting qualities with great strength and reliability. The body is made of gun metal and the jaws are faced with tempered tool cast steel. The bar is solid and the operating mechanism consists of four small pieces in addition to the lever and a small bar spring. These parts are made of the best material and are easily assembled or removed if necessary. They are so arranged that when the lever is pulled forward in the locked position the jaws are held firmly in place and cannot possibly be released until the lever is pushed back. The vise holds equally well for filing or chipping, and for bench work has proven to be a most satisfactory time saving appliance.


Fisher Quick Acting Vise.

VENEZUELA CENTRAL RAILWAY EXTENSION.—The directors of the Venezuela Central Railway Company, Ltd., have received advices from their manager in Caracas that the extension of the railway from Soapire to Santa Teresa has been opened to public traffic.

# YOUNG LOCOMOTIVE SUPERHEATER

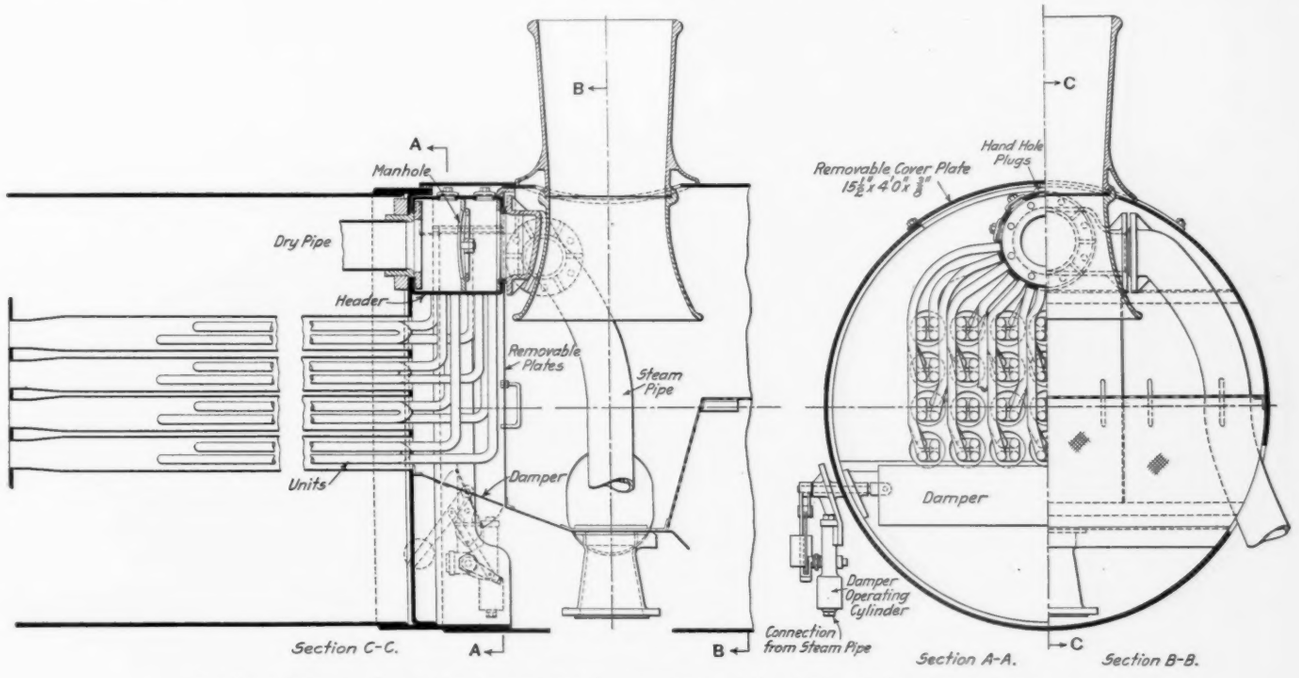
## Ends of Unit Pipe Expanded in Holes in Small Steel Plate Header. Pipes Welded at Return Bends.

The Young locomotive superheater is of the fire tube type and consists of any required number of double loop unit pipes arranged in enlarged boiler flues set in horizontal rows across the upper part of the boiler in the same manner generally used in the Schmidt design. The two ends of each unit connect to a steel plate header located near the top of the front end, adjacent to the front tube sheet. This header is divided in two compartments, one for saturated steam and the other for superheated. The former has a direct connection with the end of the dry pipe and the latter opens into a cast iron Tee head which connects to the steam pipes leading to the cylinder. A steel plate box encloses the part of the superheater in the front end and is fitted with a damper in the bottom in the same general arrangement customarily employed on other fire tube superheaters.

There are six features of particular interest in the design which has been patented by C. D. Young, engineer of tests, Pennsylvania Railroad. These are the use of a small steel plate header; the connecting of the ends of the unit pipe to the header by means of an expanded joint; a steel connection instead of a cast steel return bend at the ends of the loops in the unit pipes; the arrangement of units so that any one can be removed with the removal of but one other if it is in the upper rows and no other if it is in the bottom rows; arrangement of dry pipe so that it may be removed without disturbing any of the superheater units, and arrangements for tightening the unit pipes to the header without disturbing any of the front end apparatus or appliances.

The header is in the form of a drum of sufficient diameter to allow the dry pipe to pass through it. It is secured in place on the front tube sheet in the location occupied by a Tee head in a saturated steam locomotive and has a steam tight connection to the end of the dry pipe as is shown in the illustration. The plate dividing it in two compartments is welded in place and contains an opening or manhole of a size to permit the dry pipe to pass through it. This opening is closed by a specially constructed sealed cover. There is a reinforcing plate at the front face of the drum and the Tee head connects to it with a ground joint of the usual type. The Tee head is arranged for connections to the steam pipes which lie in a vertical plane parallel to the center of the boiler and will permit the removal of the head without disturbing the lower connections of the steam pipes. The holes in the bottom of the header for connection to the unit pipes are formed the same as the boiler tube holes in the front tube sheet and the unit pipes are connected to them in the same manner as boiler tubes by means of a Prosser or roller expander. Beading, of course, is not necessary, as there is but little tendency for them to pull out and it is only necessary to make a steam tight joint. There are hand holes in the upper part of each of the compartments, that are closed by a special type of hand hole plug which can be inserted from the outside and is sealed by a copper gasket or ring. This type of plug has been in successful use on superheaters in stationary practice for many years. Above the whole header a section of the front end sheet is cut out and fitted with a removable cover plate which will permit access to the top of the header from the outside of the locomotive. In addition to the hand holes in the upper part of the header there are also small openings diametrically opposite the entrance of each of the unit pipes. These are closed with a small plug, the design of which is similar to the special hand hole plug already referred to.

The method of inserting a unit is to remove one of the hand holes and the small plugs from the openings directly opposite the two joints. A Prosser or roller expander is then inserted in the hand hole and properly placed and an extension is inserted through the small opening and con-




**Sections Showing Small Header and the Arrangement of the Units of the Young Superheater.**

nected to the roller. An air drill or hammer can then be used on the outside and the joints properly made.

When it is necessary to remove a unit, either of two methods can be used. A flue cutter can be inserted in the same manner as the expander and the pipe is cut off even with the joint, or a flue pusher can be used pushing the flue from the sheet. The ends in the latter case are swedged down to a gage below the size of the hole before being replaced. As will be seen in the illustration, the vertical section of the unit pipe at the front are offset to each side and so arranged that it is possible to remove the units from the two bottom rows without interfering with any of the others and it is also possible to remove unit pipes from either of the top rows by the removal of one other unit. If a unit is removed by cutting off, the slight loss in length is made up by changing the position of one of the bends slightly. This can be done cold without damage to the pipes. The flue pusher method of removal, however, is to be preferred.

In place of using cast steel return bends into which the unit pipes are screwed or welded, this design employs a welded joint between the two sections of pipes. This joint is made by first bending the ends of the pipe to an angle of about 45 deg. and then sawing them off on a line parallel to the axis. These two parts are then brought together and electrically welded. This construction is used at all of the return bends.

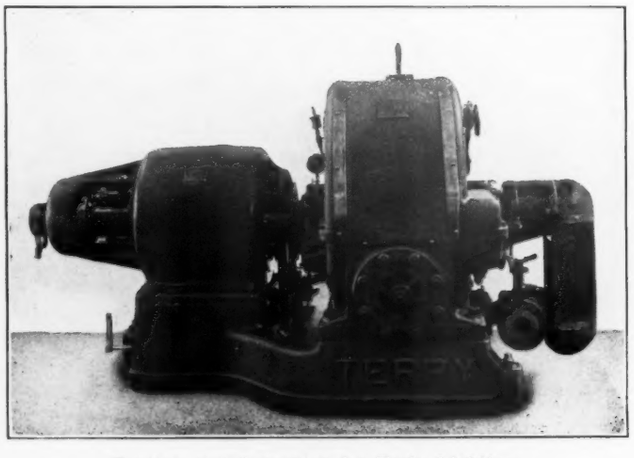
The damper operating mechanism is of the customary form which closes the damper by means of a counter weight when the throttle is closed and opens it only by steam pressure on the opening of the throttle.

Removable plates are arranged in the front of the damper box to facilitate cleaning and the removal or examination of any of the connections.

This superheater is being built by the Power Specialty Company, 111 Broadway, New York.

## TERRY TRAIN LIGHTING SET

A 25-k. w. non-condensing turbo-generator set for head-end electric train lighting has recently been developed by the Terry Steam Turbine Company, Hartford, Conn. The turbine and generator, connected by flexible shaft, are mounted on a common base with all moving parts so guarded that there is little possibility of danger to passers-by. The set is intended for installation in the baggage car, and weighs 3,400 lbs. Running at 3,000 r. p. m., it gives current at 125 volts. The set, being entirely self-contained, embodies features of ruggedness, reliability in operation, and freedom from repairs.



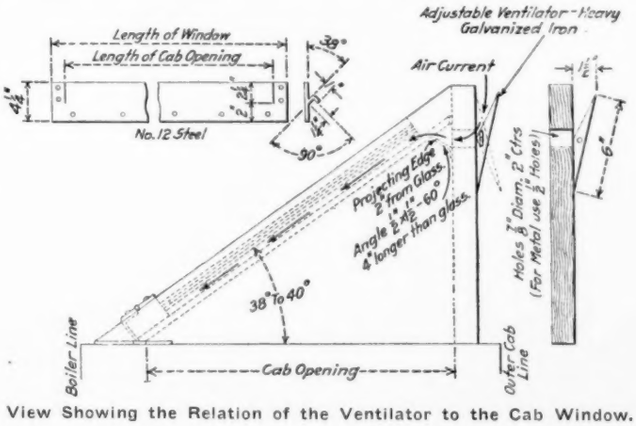

Turbine and Generator for Train Lighting.

Because of the rocking motion of the car, forced feed lubrication is used, thus giving a positive flooding of the journals and maintaining the best efficiency. An emergency governor provides complete control of the speed and voltage. The lagging on the turbine and the protective casing over the governor mechanism prevent injury to those working in the car or passing through it.

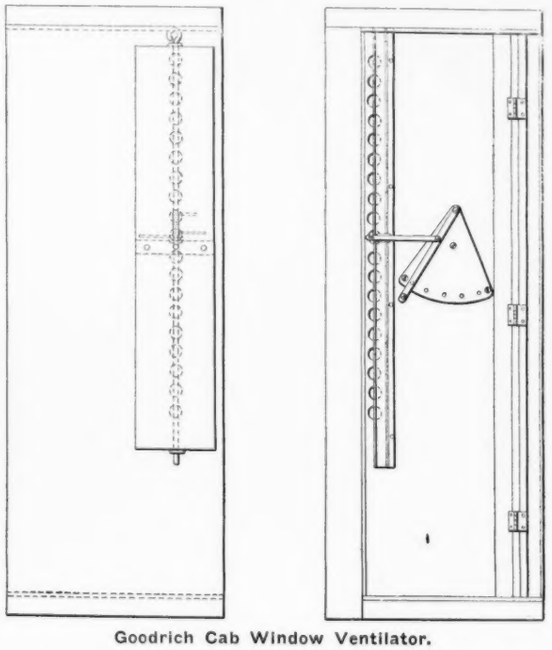
Among the special features of this turbine are the indestructible rotating element, which is so rugged that the masses of water passed through it, when the turbine is started up cold, cause no trouble. The full power of the machine may be obtained in less than a minute under adverse conditions.

## CAB WINDOW VENTILATOR

One of the greatest annoyances to a locomotive engineman in the winter time is the collection of frost on the cab window, requiring him to keep his side window open for the observation of signals. In order to overcome this, and to provide ventilation in front of the cab when the window is closed, the window shown in the accompanying illustration has been invented by Charles M. Goodrich, Clinton, Iowa. The window is set out at an angle of 38 to 40 deg. from the point where the cab meets the boiler. A series of 7/8-in. holes are placed in the extended side of the cab just inside of the window, through which air is forced by an adjustable ventilator. A small vane is placed on the inside edge




View Showing the Relation of the Ventilator to the Cab Window.

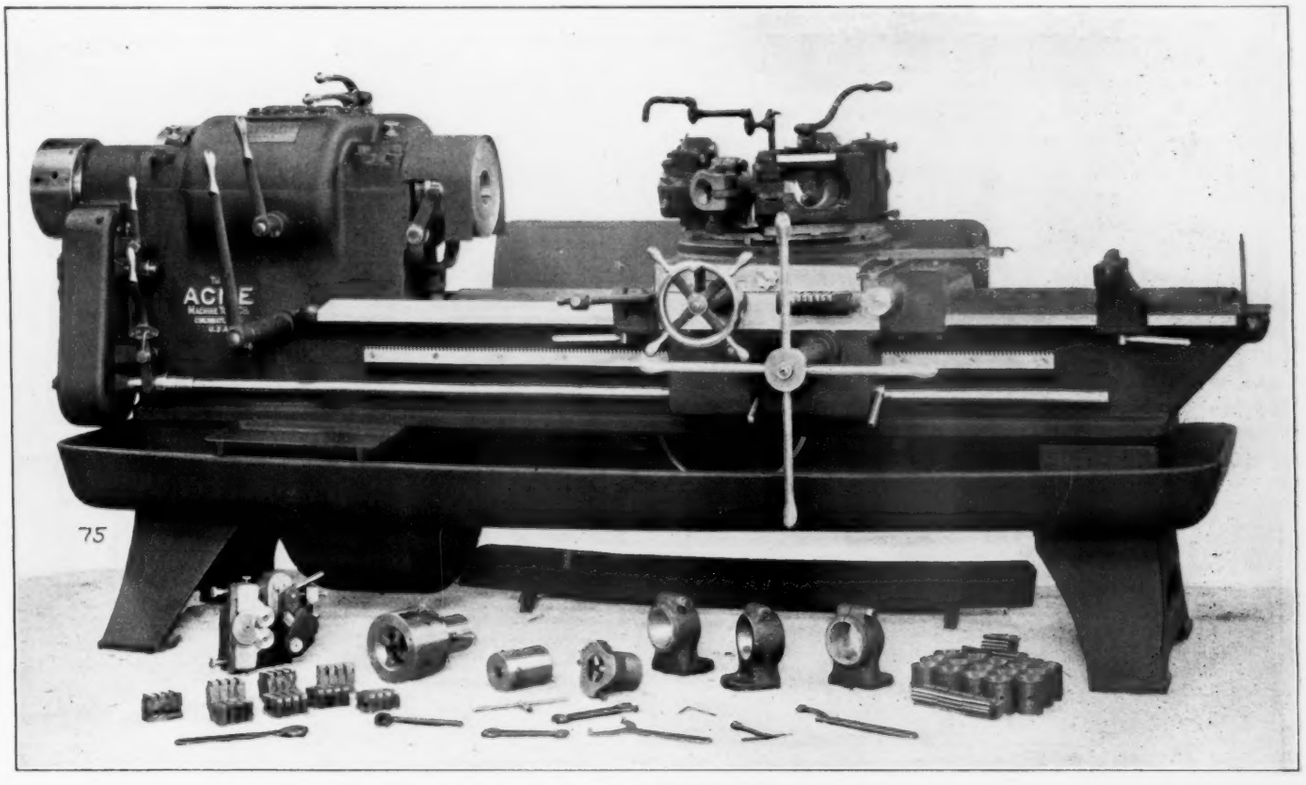


Goodrich Cab Window Ventilator.

of these holes to further guide the air against the inside surface of the glass. By doing this, the temperature of the air on both sides of the glass will be kept very nearly the same, and condensation in cold weather will be prevented. The ventilator is pivoted so that the amount of air passed through these holes may be regulated. There are six positions of adjustment from the totally closed position to the maximum opening. The ventilator is operated through a series of small levers and a quadrant, as indicated in the drawing. This window does not in any way interfere with the passage of a man from the cab to the running-board, and it has found extensive use on some large railways operating west of Chicago.

## ACME COMBINATION FLAT TURRET LATHE

A turret lathe that is adaptable to both bar and chucking work, having a maximum capacity for bar work of 3¼ in. in diameter and 36 in. long, while all classes of chucking work up to 16 in. in diameter may be machined, is shown in the illustration. In the photograph the machine is shown as fitted for bar work, but this design can also be furnished as a plain machine without the bar equipment if desired.



Acme Combination Flat Turret Lathe with Bar Equipment.

Among the prominent features of this machine is the single pulley drive; the rigidity of the head, it being cast solid with the bed, thereby obtaining a permanent alinement of the spindle with the vees and cross slide; the cross sliding turret with its long and narrow dovetailed guides; the positive automatic chuck with hardened and ground parts, the simplex roller feed, the reversing power cross and longitudinal feeds, and centralized control and safety stops in all directions.

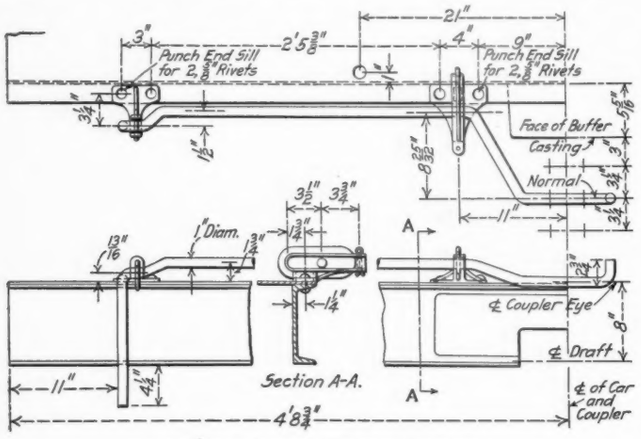
This machine is provided with 12 longitudinal feed stops and 8 cross feed stops. One independent stop is provided for each turret face. Six auxiliary stops which are operated by the knob on the front of the slide, can also be used in any combination desired with the independent stops. The stops are arranged to trip the power feed in either direction, and in doing chuck work as many as seven different lengths may be turned without indexing the turret. Nine different spindle speeds are obtained through the adjustment of gears in the head which run in an oil bath. The speeds ranging from 14 to 285 r. p. m. are obtained quickly without noise, being controlled by two of the levers that will be seen to be conveniently located at the front of the head.

The machine may be driven by a 3½ in. belt over a 12 in. single pulley which should run at a constant speed of 600 r. p. m. A positive automatic chuck is especially designed to hold the work accurately and may be opened and closed while the machine is running by the long lever at the front of the head. It is so designed that the work does not have end motion, while the chuck is being closed, thereby providing accurate shoulder lengths. The jaws do not collapse and short work may be performed without danger of tilting. An adjustment of 1/16 in. in diameter, larger or smaller, allows for small variations. The simplex roller feed is simple in design and operation, as only one adjustment is necessary. It is operated by the same lever that actuates the automatic chuck. Both the longitudinal and cross feeds are of the gear type. All feed changes are obtainable by the lower lever and can be reversed through the upper lever, both being located on the front of the head stock.

One of the most important features of the design is the centralized control, this being arranged so that the time between operations has been reduced to a minimum. The various levers, such as the longitudinal turnstile, cross feed hand wheel, cross and longitudinal stops and power feed levers, binder handle and stock stop are directly in front of the operator. A 5 h. p. constant speed motor that has a speed of from 1,200 to 1,800 r. p. m., is recommended for use with this machine by the manufacturers. It is built by the Acme Machine Tool Company, Cincinnati, Ohio.

## NATIONAL COUPLER RELEASE RIGGING

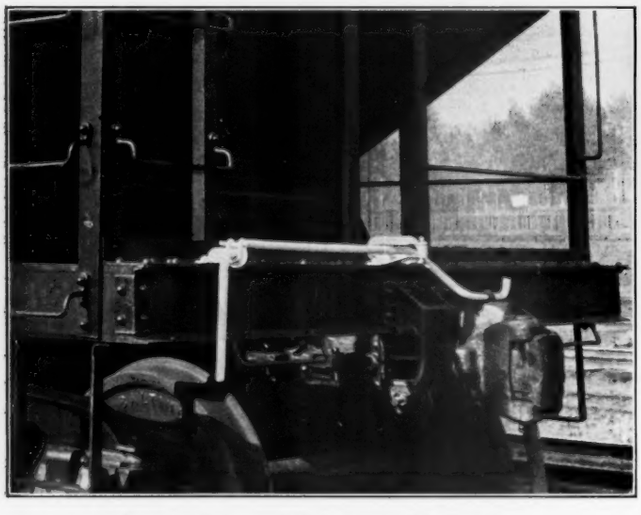
A release rigging which employs a minimum number of parts necessary to operate the uncoupling mechanism of an M. C. B. top lift coupler is shown in the illustration. This consists of an operating lever of 1 in. round bar, bent to the shape shown, and two malleable iron brackets riveted to the end sill. The side movement of the coupler head is allowed by the slip connection of the lever in the eye of the coupler lock and the draft gear movement by the slot in the bracket located nearest the coupler, with the outer bracket acting as the center of rotation. When




National Coupler Release Rigging.

releasing the coupler by hand, the operating lever rotates in the two brackets and the movable bearing in the inside bracket allows an adjustment so that the coupler lock is lifted at the angle which is the best suited to the particular type of coupler being operated.

It will be seen that the lever has a three point bearing, viz.: in each of the two brackets and in the coupler lock eye. This obviates the necessity of setting the lever handle back against the sill face to prevent sagging of the reach arm and makes it possible to design the lever with a good clearance between the



Coupler Release Rigging on a Hopper Car.

handle and the sill face. In this way the handle is allowed to accommodate itself, in the case of interchange coupler applications to the difference in the height of the eye of the coupler lock as well as the cases where the coupler sags from its original position.

It will be noticed that the lever has a limited movement in this bracket so that an abnormal forward movement of the coupler, as in the case of the coupler becoming detached from the draft gear, will result in the lever tending to unlock the coupler and release the adjoining car, preventing the coupler from being entirely pulled out of the end sill and falling to the track.

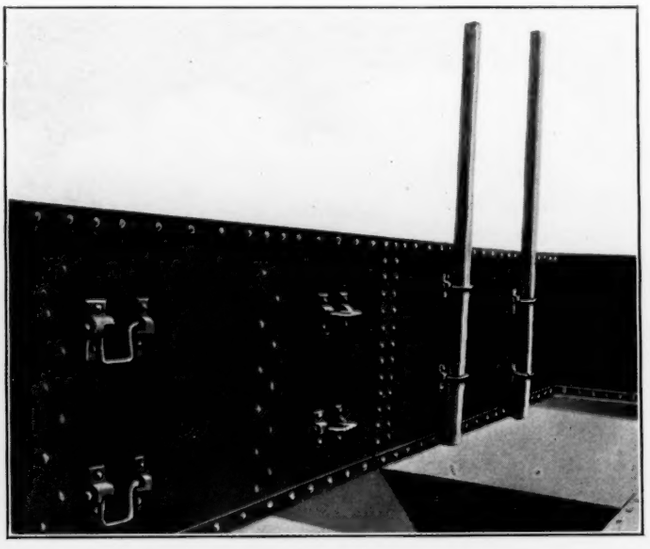
It will be noted that the lever is simply a 1 in. round steel bar from end to end, bent to fit the particular car to which it is applied. In case it becomes distorted in service, the removal of the two cotter pins which hold the lever in the brackets will allow it to be disconnected from the car. By using the lever on the opposite end of the car as a pattern, it is an easy matter to bend it back to its original shape without the use of any special dies.

There is a slight offset in the operating lever near the outside bracket which holds it in the same position laterally at all times, thus insuring the desired amount of forward and backward movement within the slotted bracket.

This rigging is manufactured by the National Railway Devices Company, 490 Old Colony building, Chicago, Ill.

## COLLAPSIBLE STAKE POCKET

A new stake holding device for freight cars has recently been developed by the U. S. Metal and Manufacturing Company, New York. The device can be applied to a car in the same position where the strap or cast pocket is now attached. The advantages claimed for this type of stake pocket are, that when not in use it drops to the side of the car, thereby increasing the inside width of the car for such forms of lading as lumber, structural shapes,



Collapsible Stake Pocket Applied to a Car.

piping, pig-iron, etc., and it also prevents damage to the pockets or lading in loading and unloading. When loading material requiring stakes, the pockets are raised to a horizontal position and moved to the rest lug on the right, after which the stakes are applied. The pockets are strong, of simple construction and always available for stakes of M. C. B. dimensions. A large percentage of the old type pockets are constantly out of repairs; they are expensive to maintain and facilities for repairs are not provided at loading points, resulting in the improper application of stakes or stakes that do not meet the M. C. B. requirements. It is claimed that the breaking load of the stake over the round section of this pocket is 18 per cent. greater than that over the square edge of the strap pocket. The round section also makes the driving of the stake easier, as well as more secure. The pockets have been thoroughly tested out in actual service for over a year with excellent results.

# NEWS DEPARTMENT

The roundhouse of the Minneapolis, St. Paul & Sault Ste. Marie at Portage, Wis., was burned on November 12.

The Chicago & Alton coal chutes at Kansas City, Mo., were destroyed by fire on November 13, together with several freight cars.

The car shops of the Boston & Maine at Fitchburg, Mass., were damaged by fire on the evening of November 10; loss, including damage to eight passenger cars, $60,000.

James J. Hill, L. W. Hill and a party of officials and directors of the Hill roads, took part in the formal opening of Glacier National Park for the winter season on November 5.

A shipbuilding firm at Philadelphia has a contract to build a vessel 350 ft. long and 50 ft. beam, to be used as a car ferry between Key West, Fla., and Havana, a distance of about 80 miles.

A press despatch from Prague, Austria, November 20 reports that Jules Vedrines, the French aviator, on that day flew from Nancy, France, across Germany without descending, and landed near Prague at 2:20 p. m. The distance covered was about 400 miles.

The proceedings of the New York Railroad Club for the meeting of October 17, contain in addition to the paper and discussion on Vanadium steel in locomotive construction a full list of the membership of the club with titles and addresses, and also an index of the proceedings from 1895 to date.

The "Santa Fe De Luxe" train, the 63-hour train to Southern California on the Atchison, Topeka & Santa Fe, will begin its third winter season on December 9, and will leave Chicago every Tuesday during the winter months. The train this year will be composed wholly of new cars.

In the subways of New York City, operated by the Interborough Rapid Transit Company, 15 barrels of grease are used each month to lubricate rails on curves; this for the purpose not only of reducing the wear due to friction, but to prevent the disagreeable noises which otherwise would annoy passengers. The tracks on the curve at Times Square are greased five times every twenty-four hours.

Two all-steel business cars to be used by officers of the Pennsylvania Railroad to transact railroad business while traveling will soon be finished at the Altoona shops. By the use of the business cars last year Pennsylvania officers, while traveling 159,517 miles, were able to conduct the affairs of the railroad just as if they had been in their own offices. With these cars finished, the Pennsylvania will have four steel office cars.

The office of the Weather Bureau at Washington has issued a memorandum concerning the floods which occurred in Ohio and Indiana last March, and it is estimated that the total money loss by these floods was $163,000,000. This includes loss to railroad, telegraph and telephone lines and to farms and farm property, including prospective crops. The latter alone amounted to about $11,000,000. Of the total amount more than 70 per cent. was sustained in Ohio and Indiana.

A study of the economic cost of the smoke nuisance in Pittsburgh was undertaken in connection with the smoke investigation in March, 1912. The work was begun by Dr. C. W. A. Veditz. The Mellon Institute of Industrial Research & School of Specific Industry has just issued smoke investigation bulletin No. 4, prepared by John J. O'Connor, Jr., and dealing with this subject. Estimates are made of the cost of the smoke nuisance to the various types of industry in the community as well as the loss due to imperfect combustion, and an itemized bill showing the partial cost to the people of Pittsburgh is included, the total of which is $9,944,740.

## CHANGE IN LIGHTING OF NEW HAVEN CARS

The indirect lighting system of the Merchants' Limited, one of the New Haven road's five-hour trains between Boston and New York, is to be supplemented by the installation of tungsten lights along the beam on the lower deck of each car; this to increase the light for reading purposes, concerning which there has been some complaint. When first installed the inverted globes suspended from the ceiling of the cars each contained one 100-Watt tungsten lamp. By displacing these with three 50-Watt lamps an increase of 50 per cent. in the amount of light was obtained, but even with this change we are informed, some of the regular users of the trains complained of difficulty in reading in the "soft radiance" that pervades the cars.

## SAFETY OF RAILWAY TRAVEL

There is an exaggerated idea of the danger of railway travel. There are a number of cities and some entire states in which records of the causes of deaths have been compiled by the Census Bureau. These are embraced in what is termed the registration area, which includes twenty-two states and the larger cities in fifteen other states. The registration area is estimated by the United States Census Bureau to embrace 63.1 per cent. of the total population of the United States. For the calendar year 1911, the Census Bureau reported 42,331 cases of accidental death, exclusive of railway accidents, in the registration area. As bearing on the comparative safety of different ways of travel, it may be noted that, as compared with 318 deaths of passengers from railway accidents in the entire United States, there were, in the registration area, 1,883 deaths from street-car accidents, 1,291 from automobile accidents, and 2,237 from accidents in connection with other vehicles. The total number of deaths in the registration area from accidents in connection with street cars, automobiles, and other vehicles in the calendar year 1911 was 5,411, or more than the total number of passengers, railway employees, and all other persons, excepting trespassers, killed in railway accidents of all kinds in the twelve months ended June 30, 1912, including accidents in railway shops.—*W. W. Finley.*

## THE FIRST PULLMAN CAR

Fifty-six years ago J. L. Barnes, of Chanute, Kan., was a conductor on the first Pullman car ever run. He made the trip between Bloomington, Ill., and Chicago, over the Chicago & Alton on the night of September 1, 1857, and one of his passengers was George M. Pullman. Mr. Barnes recalls that Mr. Pullman on the next morning was somewhat doubtful as to the ultimate success of his invention. Mr. Barnes is 78 years old and it would probably be rather unfair to visit him with the punishment to which he is clearly entitled, but he told how he stood idly by and permitted the first Pullman porter in history to maltreat a passenger with a whisk broom and collect the original Pullman tip. He was a husky lad of 22 summers at that time and his muscles were in a good state of vigor, but he did not interfere.

The car was a remodelled day coach and there were four compartments, eight berths, four upper and four lower. The

people of Bloomington, little reckoning that history was being made in their midst, did not come down to the station to see the car. There was no crowd and the car, lighted by candles, moved away in solitary grandeur, if such it might be called.

Mr. Barnes retired as division superintendent of the Atchison, Topeka & Santa Fe in 1910, after a railroad service covering fifty-six years.—*Exchange.*

## THE COURSE IN RAILROADING

Walker M. Van Riper, who has made a study of legislation affecting railroads and public service corporations, tells this: "At a time when the legislature of the new state of Arizona was passing a big batch of bills affecting railroads, a young man called on President Wilde of the University of Arizona, and asked him if a course of instruction in the railroad business could be had in the university. The president said perhaps it could be arranged, and the young man then asked how long it would take and how much it would cost.

'"That depends on how much you want to learn,' President Wilde told him. 'If you want to learn as much as a division superintendent knows, it will take 10 years and cost you $10,000. If you want to know as much about the railroad business as the Arizona legislature knows, it will take 15 minutes and will cost you 75 cents.'"—*St. Louis Post Dispatch.*

## APPEALING TO TRESPASSERS DIRECT

On the Baltimore & Ohio a trackwalker patroling the road, or a section foreman or one of his workmen when meeting a person tramping along the tracks, whether it be a confirmed hobo or a respectable citizen like a mill employee, points out to him the danger which lurks in this careless practice. The appeal is backed up by information as to the number of lives that are sacrificed and the permanent injuries that occur each year as a result of people using the railroad as a public highway. The maintenance of way department has a representative on the safety committees of the company, and through these officers the men at work on the tracks are made acquainted with accident statistics. Already there has been an appreciable reduction in the number of deaths and serious injuries. The Claims Department of the road attributes this in large measure to the efforts of the track forces in calling attention to the dangerous practice. Recently a trackwalker was passing a factory adjacent to the right of way just as the factory operatives were coming out. Four young women started up the tracks towards their homes, walking on one of the main tracks. The trackwalker impressed upon the women the danger they were assuming, fortifying his statement by telling them that Miss Pearl Williamson, having assumed the same risk, had lost her life, Miss Williamson having been the twelfth person killed in the same manner on that division during the past year. Presenting the matter with due force he convinced his audience, and now the employees have discontinued using the tracks as a highway.

## RECORDS OF TWO ENGINEMEN

H. W. McMaster, general manager of the Wheeling & Lake Erie, has called attention to the remarkable records of two of the enginemen on that road.

Michael Donivan entered the service of the Wheeling & Lake Erie as an engineer on March 11, 1883, and after over 30 years of continuous service with very few vacations, he resigned, effective October 31, 1913. The records show that during the full period of his employment he never had occasion to go to the superintendent's or master mechanic's office on a matter of discipline, and so far as can be learned he was never even reprimanded by any officer connected with either the transportation or mechanical departments. The only entries on his record are of a commendatory nature and wherein credit marks were allowed; and now at the age of 55 he leaves railroad service in perfect physical condition.

Another man of long service with the company is Ira Cowen, who has been an engineman since November 5, 1881. He was born in 1842, and after having served for three years in the army during the Civil War, was for 17 years in the service of the Atlantic & Great Western, as fireman for two years and engineman for 15 years, leaving that company to go to the Wheeling & Lake Erie with a clear record. During his 32 years on the Wheeling & Lake Erie his service has been continuous, with the exception of a slight interruption brought about by an injury sustained while riding on a train as a passenger. Mr. Cowen has filled the position of engineman for 47 years, without a demerit mark being placed against his record.

## MEETINGS AND CONVENTIONS

*American Museum of Safety.*—A conference on safety and sanitation is to be held in Rumford Hall in the Chemical building, 50 East Forty-first street, New York, December 10, 11 and 12. This conference is to be held under the auspices of the American Museum of Safety, and will be in connection with the International Exposition of Safety and Sanitation. This movement is a part of the educational work now being done to decrease accidents and suffering, and to increase industrial efficiency. Among the subjects to be discussed are Industrial Accidents; Accident Prevention and the Public; Industrial Hygiene; Employer and Employee, and The Coming Generation.

*The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.*

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass.

American Railway Master Mechanics' Assoc.—J. W. Taylor, Karpen building, Chicago.

American Railway Tool Foremen's Association.—A. R. Davis, Central of Georgia, Macon, Ga.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 18-22, 1914, Chicago.

International Railway General Foremen's Association.—William Hall, 829 W. Broadway, Winona, Minn.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 18-20, 1914, Milwaukee, Wis.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty St., New York. Convention, May 25-28, 1914, Philadelphia, Pa.

Master Car Builders' Association.—J. W. Taylor, Karpen building, Chicago.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

## RAILROAD CLUB MEETINGS

| Club. | Next Meeting. | Title of Paper. | Author. | Secretary. | Address. |
|---|---|---|---|---|---|
| Canadian | Dec. 9 | First Aid to the Injured | L. R. Johnson | Jas. Powell | Room 13, Windsor Hotel, Montreal. |
| Central | Jan. 9 | | | H. D. Vought | 95 Liberty St., New York. |
| New York | Dec. 19 | Annual Christmas Smoker | | H. D. Vought | 95 Liberty St., New York. |
| Pittsburgh | Dec. 19 | Locomotive Boiler Design | A. W. Whitiford | J. B. Anderson | 207 Penna. Station, Pittsburgh, Pa. |
| Richmond | Dec. 8 | | E. D. Hotchkiss | F. O. Robinson | C. & O. Ry., Richmond, Va. |
| St. Louis | Dec. 12 | Efficiency in Handling Railway Equipment. | J. R. Cavanagh | B. W. Frauenthal. | Union Station, St. Louis, Mo. |
| Western | Dec. 16 | Locomotive Boiler Inspection | Frank McManamy | Jos. W. Taylor | Karpen Bldg., Chicago, Ill. |

# PERSONALS

*It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.*

## GENERAL

J. F. ENRIGHT, superintendent of motive power and car department of the Denver & Rio Grande, with headquarters at Denver, Colo., has had his jurisdiction extended over the Western Pacific.

W. J. FREY has been appointed supervisor of materials of the Lake Shore & Michigan Southern, with headquarters at Cleveland, Ohio, succeeding H. W. Gardner, resigned.

GEORGE H. FUNK, formerly superintendent of fuel economy of the Chesapeake & Ohio, has been appointed chief smoke inspector for all the railroads entering Cincinnati, Ohio.

JOHN KRUTTSCHNITT has been appointed mechanical inspector of the Illinois Central, with headquarters at Chicago.

## MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

HUGH D. MACKENZIE, whose appointment as division master mechanic of the Intercolonial Railway, with headquarters at Stellarton, N. S., was announced in the November number, was born July 22, 1864, at Churchville, Pictou county, N. S., and was educated in the public schools of Moncton, N. B. He began railway work on July 24, 1881, with the Intercolonial Railway as a machinist apprentice, remaining in that position until 1886, and then for twelve years was machinist. He was appointed charge hand at Moncton, N. B., in 1898, and the following year became mechanical foreman at Stellarton, N. S., remaining in that position until 1909, when he was appointed general locomotive foreman at Moncton, N. B., which position he held at the time of his recent appointment as division master mechanic of the same road, with headquarters at Stellarton, N. S., as above noted.

H. D. Mackenzie.

WALTER U. APPLETON, whose appointment as general master mechanic of the Intercolonial and the Prince Edward Island railways, with headquarters at Moncton, N. B., was announced in the November number, was born January 29, 1878, at Moncton, and was educated in the public schools. He began railway work on October 13, 1890, with the Canadian Government Railways as a junior clerk. From 1895 to 1899 he was apprentice machinist and then was clerk, for one year, becoming machinist in 1901. Two years later he was made chief clerk to the superintendent of motive power, remaining in that position until 1907. He was appointed assistant to superintendent of motive power in 1909, which position he held at the time of his recent appointment as general master mechanic, as above noted.

ROBERT F. BYERS, formerly shop foreman of the National Railway of Mexico, at Aguascalientes, Mex., has been appointed master mechanic of the Central Dominicano Railway, with headquarters at Porto Plata, Dominican Republic.

EDWARD M. SWEETMAN, whose appointment as master mechanic of the Southern Railway, with headquarters at Princeton, Ind., was announced in the November number, was born February 22, 1874, at Joplin, Mo., and was educated in the common schools. He began railway work on October 16, 1898, with the East Tennessee, Virginia & Georgia line of the Southern Railway as an apprentice. In 1905 he was promoted from machinist to air brake foreman, and in January, 1907, he was made erecting shop foreman. The following April he became roundhouse foreman, and three months later was transferred to Asheville, N. C., as general foreman, remaining in that position until September, 1907, when he was appointed master mechanic, on the Memphis division, with headquarters at Sheffield, Ala. On January 15, 1910, he was transferred in the same capacity to the Birmingham division, which position he held at the time of his recent appointment as master mechanic on the St. Louis division, with headquarters at Princeton, Ind., as above noted.

E. M. Sweetman.

JAMES WESLY GIBBS, who has been appointed master mechanic of the Southern Railway, with headquarters at Sheffield, Ala., as was announced in the November number, was born on August 31, 1873, in Rutherford county, N. C., and was educated in the High School, at Clyde, N. C. He began railway work in 1900 as a machinist on the Southern Railway, at Spencer, and three months later was made roundhouse foreman at the same place, remaining in that position until July, 1906; the following month he was promoted to engineer on the Asheville division. In March, 1908, he was made roundhouse foreman at Atlanta, Ga., later becoming general foreman at Asheville, N. C., on the same road. He was appointed master mechanic of the Virginia & South Western, in October, 1911, with headquarters at Bristol, Tenn., which position he held at the time of his recent appointment as master mechanic of the Southern Railway at Sheffield, Ala., as above noted.

J. W. Gibbs.

ELMER E. COPE has been appointed road foreman of engines of the Buffalo, Rochester & Pittsburgh, in charge of territory, East

Salamanca to Punxsutawney and Clearfield, with headquarters at Du Bois, Pa.

Henry Griffith has been appointed road foreman of engines of the Buffalo, Rochester & Pittsburgh, in charge of the Indiana branch and territory south of Punxsutawney, with headquarters at Punxsutawney, Pa.

J. W. Hackett, roundhouse foreman of the Forth Worth & Denver City at Amarillo, Tex., has been appointed master mechanic of the Houston Belt & Terminal, with headquarters at Houston, succeeding M. D. Stewart, resigned.

H. B. Hayes, master mechanic of the Alabama Great Southern at Birmingham, Ala., has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., succeeding Joseph Quigley, resigned.

L. L. Moebeck has been appointed road foreman of engines of the Northern Pacific, with headquarters at East Grand Forks, Minn.

T. E. Mullen has been appointed division foreman of the Atchison, Topeka & Santa Fe at Seligman, Ariz.

## CAR DEPARTMENT

F. C. Corp has been appointed car foreman of the El Paso & Southwestern, at Douglas, Ariz., succeeding F. A. Linn.

Alfred Herbster has been appointed traveling car foreman of the Lake Shore & Michigan Southern, with headquarters at Cleveland, Ohio, succeeding W. J. Frey, promoted.

A. B. McDonald, general car foreman of the Intercolonial Railway at Moncton, N. B., has been appointed superintendent of car shops at Moncton.

George Edward Smart, who has been appointed master car builder of the Intercolonial and the Prince Edward Island railways, with headquarters at Moncton, N. B., as announced in the November number, was born December 23, 1873, at Edinburgh, Scotland, and was educated in the public schools. He began railway work in August, 1893, with the Grand Trunk, and held various positions on that road until 1897, when he was promoted to car inspector. From 1904 to 1906, he was general inspector of heating and lighting on the eastern lines of the Canadian Pacific, and then to 1909, was general car inspector on the eastern lines of the same road. In 1909 he was made division car foreman in charge of passenger and freight car work on the eastern division of the Canadian Pacific, which position he held at the time of his recent appointment as master car builder of the Canadian government railways as above noted.

## SHOP AND ENGINE HOUSE

J. J. Anderson has been appointed machine shop foreman of the Seaboard Air Line at Jacksonville, Fla.

J. H. Arbuckle has been appointed shop apprentice instructor of the Atchison, Topeka & Santa Fe at Cleburne, Tex., succeeding A. E. Fairweather.

A. M. Baird has been appointed assistant superintendent of the locomotive shops of the Atchison, Topeka & Santa Fe, at Topeka, Kan., succeeding R. F. Whalen.

L. E. Bodine has been appointed foreman boilermaker of the Rock Island Lines at Pratt, Kan., succeeding J. W. Greenly, promoted.

J. L. Dufner has been appointed shop apprentice instructor of the Atchison, Topeka & Santa Fe at Albuquerque, N. M., succeeding E. L. Wood.

John C. Frye has been appointed general foreman of the Seaboard Air Line at Tampa, Fla.

William Keininger has been appointed foreman of the boiler shop of the Atchison, Topeka & Santa Fe at Topeka, Kan., succeeding A. M. Baird.

Thomas G. Knight has been appointed night roundhouse foreman of the Rock Island Lines at Biddle, Ark., succeeding H. T. Gibbons.

Bernard Lee has been appointed roundhouse foreman of the Buffalo, Rochester & Pittsburgh at East Salamanca, N. Y.

John H. Reich has been appointed shop apprentice instructor of the Atchison, Topeka & Santa Fe at Topeka, Kan., succeeding George Elliott.

W. P. Ridling has been appointed acting night roundhouse foreman of the Rock Island Lines at Dalhart, Tex.

Horace S. Rosser has been appointed general foreman of the Seaboard Air Line at Jacksonville, Fla.

## PURCHASING AND STOREKEEPING

E. A. Clifford has been appointed junior assistant general purchasing agent of the Atchison, Topeka & Santa Fe, with office at Chicago, Ill., succeeding J. J. Conn, promoted.

J. J. Conn has been appointed senior assistant general purchasing agent of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, succeeding F. E. Connors, promoted.

F. E. Connors, assistant general purchasing agent of the Atchison, Topeka & Santa Fe, at Chicago, has been appointed assistant to vice-president in charge of stores, with headquarters at Topeka, Kan.

N. M. Rice, general storekeeper of the Atchison, Topeka & Santa Fe at Topeka, Kan., has been appointed chief purchasing officer of the St. Louis & San Francisco, with headquarters at St. Louis, Mo. Mr. Rice will be in charge of purchases and stores, and will have supervision and care of all material, fuel, supplies and stationery in the possession of the receivers.

F. C. Turner has been appointed division storekeeper of the Northern Pacific at Pasco, Wash., in place of J. C. Vollmer, resigned.

## OBITUARY

Jacob Johann, from 1892 to 1897 superintendent of machinery of the Chicago & Alton, died recently at his home in Springfield, Ill. He was born at Rheinzabern, Bavaria, Germany, on November 15, 1830. He began railway work in November, 1858, and to July, 1861, was assistant to master mechanic on the Missouri Pacific; subsequently for about four years he was master mechanic of the shops on the Southwest branch at Pacific City, Mo. From March, 1865, to May, 1868, he was general master mechanic of the Missouri Pacific, and from April, 1870, to January, 1872, held the same position on that road. In October, 1872, he was appointed general master mechanic of the Chicago & Canada Southern, and from June, 1874, to November, 1884, was general master mechanic of the Wabash, St. Louis & Pacific, and then to May of the following year was superintendent of motive power and machinery of the same road. From July to November, 1885, he was master mechanic of the Missouri, Iowa & Nebraska, now part of the Chicago, Burlington & Quincy, and then to December, 1886, was master mechanic of the Chicago & Atlantic, now part of the Erie. He was appointed superintendent of motive power and rolling stock of the Texas & Pacific at Marshall, Tex., in December, 1886, remaining in that position until June, 1888; subsequently he had charge of the Chicago office of the Safety Car Heating & Lighting Company, and from November 5, 1892, to February, 1897, he was superintendent of machinery of the Chicago & Alton. Previous to entering railway service he was for 12 years employed in various locomotive work.

Efficiency Tests on the Pennsylvania.—During August, 1913, on the Pennsylvania, the conformity of enginemen with speed regulations was tested in 6,570 cases, with 21 failures.

# SUPPLY TRADE NOTES

The Quigley Furnace Company has moved its general offices from Springfield, Mass., to 105 West Fortieth street, New York.

The J. Faessler Manufacturing Company, Moberly, Mo., has moved its St. Louis, Mo., office from 810 Olive street to the Railway Exchange building.

Charles A. Eggert, who for the past 12 years has been with the Consolidated Car Heating Company, has been made sales engineer of the Railway Utility Company, Chicago.

Horace L. Winslow has disposed of his interest in the Okadee Company. He will give his time exclusively to the Horace L. Winslow Company, Inc., owners of the Winslow locomotive boiler washing and refilling system, which has been installed on a number of leading railroads. The offices of Horace L. Winslow Company, Inc., will remain at 990 Old Colony building, Chicago.

The Easton Car & Construction Company, Easton, Pa., a new concern, has purchased all the stock, rights, plants, office records, equipment and good-will of the Ernst-Wiener Company, New York. W. E. Farrell is the leading spirit in the new company. While the change in ownership is complete the business will be conducted as heretofore. The Easton Car & Construction Company will make industrial railway equipment, including cars, track, and other appurtenances, and, as a new venture, will make plate, tank and structural steel up to ½ in. in thickness. The company has a newly erected plant at Easton, Pa., which is completely equipped with new special machinery specially adapted to the manufacture of the Ernst-Wiener products. Everything will be sold hereafter under the trade name of the Easton Car & Construction Company.

Adelbert B. Stetson, consulting engineer for the Bucyrus Company, South Milwaukee, Wis., and formerly vice-president of that company, died on October 27, aged 72 years. Mr. Stetson became connected with the Bucyrus Company in 1888, when he was made superintendent of the old plant at Bucyrus, Ohio. He later had charge of the construction of the new plant at South Milwaukee, Wis., and was subsequently general superintendent for ten years, being chosen vice-president of the company in 1901. He resigned in 1904 to devote his entire time to various dredging and gold-mining interests with which he had been identified for a number of years. Subsequently, however, he again became associated with the Bucyrus Company as consulting engineer, in which capacity he remained until his death During the past year he gave considerable time to the supervision of gold-dredging operations in Idaho, and while engaged in this work a severe illness made it necessary for him to return to Milwaukee, where an operation was performed which resulted in his death. Mr. Stetson was one of the first Americans to be identified with the construction of the Panama canal.

A corporation has been formed with a New York state charter to engage in the manufacture on an extensive scale of a full line of Diesel engines, both stationary and marine. The company has strong American backing and also to a large extent that of the Swedish capitalists who now control the Swedish Diesel Motor Company. The new corporation will take over the plant and organization of the McIntosh & Seymour Company of Auburn, New York, well known as builders of steam engines. The present steam engine business will also be continued as heretofore. The name of the new company is McIntosh & Seymour Corporation. The Board of Directors is as follows: Marcus Wallenberg, president Stockholms Enskilda Bank, Stockholm, Sweden; Frank A. Vanderlip, president National City Bank, New York; Thatcher M. Brown, Brown Bros. & Co., New York; Edwin S. Church, Auburn, N. Y.; J. A. Seymour, Auburn, N. Y.; Franklin B. Kirkbride, New York; Oscar Lamm, Stockholm, Sweden, and Philip W. Henry, New York. The general counsel is W. M. Coleman, New York, N. Y. Edwin S. Church, formerly superintendent of the Akron plant, International Harvester Company, will be executive head of the new corporation; J. A. Seymour, president of the McIntosh & Seymour Company, will be vice-president, in charge of engineering. The initial capitalization will be $2,200,000.

Edwin S. Woods, head of the railway supply firm of Edwin S. Woods & Co., Chicago, Ill., died on November 15 at the home of his parents in Chicago. He was the son of Major John L. Woods, who was formerly president of the Allen Paper Car Wheel Company and western representative of the Railway Steel Spring Company, and is now with the Buckeye Steel Castings Company. Edwin S. Woods organized the company, of which he was president in 1903, and was previously vice-president of the Kindl Car Truck Company, Chicago. It is announced that the business of the company will be continued along the same lines as previously. Mr. Woods was 42 years of age, and well known among railway and railway supply men throughout the country.

Edwin S. Woods.

E. E. Hudson, sales manager of the Primary Battery department of Thomas A. Edison, Inc., Orange, N. J., has been made fourth vice-president of that company. Mr. Hudson will continue as heretofore in charge of the sales of the Primary Battery department, with headquarters at Orange, N. J. Mr. Hudson entered the signal supply business in July, 1898, with the Edison Manufacturing Company, as chief clerk in the Primary Battery department. He remained with that company until June, 1902, when he left to become treasurer of the Peerless Fashion Company. After a few months he resigned that position and went to the United States Steel Corporation as accountant in the comptroller's department. This position he retained until December, 1903, when he was made secretary and treasurer of the Battery Supplies Company, Newark, N. J. In 1905 he was made also sales manager of that company. In 1908 he returned to the Edison company upon the absorption of the Battery Supplies Company, as assistant manager of sales in the Primary Battery department. He was made manager of sales of that department in February, 1909, which position he retained until his election as fourth vice-president of the company, as mentioned above.

E. E. Hudson.

# CATALOGS

EMERY GRINDERS.—Several sizes of grinders suitable for abrasive wheels of all kinds are illustrated in a leaflet from the Canton Foundry & Machine Company, Canton, Ohio. In each case the machine is illustrated; a table of dimensions is given and the price lists of the various parts are included.

BOILER CLEANERS.—A booklet bearing the title of, "Economical Steam Production," prepared by G. L. Simonds & Co., 115 South La Salle street, Chicago, contains valuable engineering data in connection with the relation of soot to boiler efficiency which has never before been published. It deals principally with the advantages of the Vulcan soot cleaner and is fully illustrated.

BALL BEARINGS.—A brief discussion of ball bearings and their application to axle lighting generators is contained in a booklet prepared by the Hess-Bright Manufacturing Company, Philadelphia, Pa. Illustrations are included showing sectional views of the generators and the recommended methods of mounting the journal. The construction throughout is thoroughly described.

TURRET LATHES.—The 3¼ in. x 36 in. Acme combination turret lathe is illustrated in a catalog being sent out by the Acme Machine Tool Company, Cincinnati, Ohio. The various parts of the machine are fully described and specifications for machines with equipment for chucking work or for bar work are included. This machine is illustrated and briefly described elsewhere in this issue.

CURTIS TURBINES.—All the latest developments in the Curtis steam turbines are fully explained in an attractive catalog being issued by the General Electric Company, Schenectady, N. Y. Turbines from 100 Kw. to 2,500 Kw. capacity and for driving 60 cycle generators at 3,600 r. p. m. are shown. The bulletin is profusely illustrated, showing details of turbine construction, path of steam flow, and a number of typical installations.

VOLTAGE REGULATOR.—The KR system of voltage regulation, which comprises a booster, combined with an automatic regulator so as to continually reverse the excitation of the booster, but with varying periodicity, is fully illustrated and described in bulletin No. 4972 from the General Electric Company, Schenectady, N. Y. This system has been designed to successfully handle larger fluctuations of voltage than the standard method.

BLACKSMITH SHOP EQUIPMENT.—General Catalog No. 179 from the Buffalo Forge Company, Buffalo, N. Y., contains over 300 pages in which are illustrated an extensive line of forges of all sizes and types, blowers of the centrifugal type, hand and power operated drills, combination wood workers, bending machines, hand and power operated shears and punches, hoods, heating furnaces, fans, pumps, etc. Each equipment is accompanied by a table giving sizes, weight and prices.

TRAVELING ELECTRIC HOISTS.—Bulletin No. 301 from Pawling & Harnischfeger Company, Milwaukee, Wis., is devoted to a very complete description of the type U electric traveling hoist, manufactured by this company. The various parts are illustrated and described in detail and sketches are given showing the dimensions and clearances required for its application. This type of hoist uses plain spur gears throughout and employs the splash oil system for lubricating all bearings.

ELECTRIC FURNACES.—A folder which illustrates and describes the construction and operation of electric furnaces for the efficient heat treatment of carbon, high speed and alloy steels is being issued by the Hoskins Manufacturing Company, 463 Lawson avenue, Detroit, Mich. This shows a number of sizes and arrangements of electric furnaces. Accurate pyrometers constructed ruggedly enough to withstand the every day work of the hardening room are used in connection with the furnaces and are described in the leaflet.

MACHINE TOOLS.—The Progress Reporter for September, issued by the Niles-Bement-Pond Company, 111 Broadway, New York, mentions and illustrates a number of the latest designs of large machine tools furnished by this company. This includes some very large lathes for turning projectiles and guns, a Niles-Bement-Pond multiple spindle milling machine, a large planer and a 20-33 ft. extension boring mill, as well as a 4 ft. horizontal surface grinder, a 22 in. vertical surface grinder, a disc grinder and a vertical shaper from Pratt & Whitney.

MILLING MACHINES.—The Cincinnati Milling Machine Company, Cincinnati, Ohio, is issuing a new general catalog on its very complete line of column and knee type milling machine, plain, universal and vertical, both cone driven and high power with single pulley drive. This catalog contains 127 pages, is 8½ in x 11 in. in size and is fully illustrated, showing the large and well equipped shops of the company, the complete machines as well as photographs and drawings of the various more important parts of the various types described. The section of the catalog devoted to the description of the universal type of milling machine is particularly complete and interesting.

LIGHT LOCOMOTIVES.—Locomotives weighing from two to five tons and for gages from 18 in. to 56½ in. with or without cab, are illustrated and described in a catalog prepared by the Bell Locomotive Works, Inc., Yonkers, N. Y. These employing a small vertical boiler with copper tubes and use oil as fuel. The engine is a two-cylinder, high-pressure, double-acting type, built in one unit, one end being geared to and supported by one main axle while the other end is hung from the main frame by a strap. The boiler and fuel and water tanks are supported on a subframe that is carried by springs from the main frame that rests directly on the axles. These locomotives are especially adapted for subway and tunnel work.

OXYGRAPH.—The oxygraph is a machine devised for cutting steel in irregular forms following the lines of a drawing placed on an adjacent tracing table. The cutting is done by means of an oxy-acetylene machine cutting torch connected to one part of a pantagraph frame, another part of which is extended out and in a suitable location for following the lines of a drawing. The machine is motor propelled so that it can be driven at a uniform, predetermined speed best calculated for the thickness of the metal to be cut. This instrument is fully illustrated and described in Bulletin No. 1, of the Davis-Bournonville Company, 30 Church street, New York. Illustrations are included, showing several complicated and difficult shapes that have been cut in this machine.

BALDWIN FORTY THOUSANDTH LOCOMOTIVE.—Locomotive No. 8661, of the Pennsylvania lines west of Pittsburgh, which is one of thirty similar engines recently built by the Baldwin Locomotive Works, is the forty thousandth locomotive turned out by this company. It is a class K-3-s, Pacific type engine and is briefly described and illustrated in a pamphlet being issued by the Baldwin Locomotive Works, Philadelphia, Pa., in honor of this event. This pamphlet includes a brief history of the Baldwin Works, which has now been in continuous operation for eighty-two years. In connection with this history are a number of interesting illustrations of early locomotives built by this company as well as some of the more recent ones. The plants of the company at Philadelphia, Eddystone and Chicago, as well as the plant of the Standard Steel Works Company, are illustrated and their size and arrangement briefly discussed. A table included in this section shows that, based on an annual capacity of 2,500 locomotives, there are 19,000 men employed, each working ten hours a day. There are eighty-five buildings comprised in the works which give a total floor area of over sixty-four acres. The works consume over 6,000 net tons of iron and steel a week and over 2,500 net tons of other material during the same period.